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ELEMENTS OF CHEMISTRY,

AND

NATURAL HISTORY.

TO WHICH IS PREFIXED

THE PHILOSOPHY OF CHEMISTRY.

BY A. F. FOURCROY.

TRANSLATED FROM THE FOURTH AND LAST EDITION OF THE
ORIGINAL FRENCH WORK,



BY R. HERON.

IN FOUR VOLUMES.

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OF

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E L E M E N T S
OF
N A T U R A L H I S T O R Y
AND
C H E M I S T R Y.

P A R T IV.

C H A P IV.

Of Fat.

THE fat is a concrete oily matter, contained in the cellular tissue of animals. It is either white or yellowish, and commonly insipid as to both taste and smell. Its solidity, colour, taste, &c. are different in different animals; nay, even in the same animal, as it is older or younger. In the infant it is white, insipid, and far from solid; in the adult person, firm and yellowish; in the old man, of a deeper colour, very various in its consistency, and generally of a stronger taste.

The fat of man and quadrupeds is consistent, and either white or yellow: The fat of birds is finer, sweeter, more unctuous, and generally less solid: In cetaceous animals

nimals, and fishes, the fat is almost fluid, and frequently disposed in certain reservoirs, such as the cavity of the cranium, and the vertebræ. It is found too in serpents, insects, and worms; but in these animals it is confined to the viscera in the lower part of the belly, where it is disposed in small lumps: only a very small quantity or it is found on the muscles, and under the skin.

It has been observed, that the fat of frugivorous and herbivorous animals is firm and solid, but that of carnivorous animals more or less fluid. It is, however, to be remarked on this head, that the fat must always be less solid, and less concrete, in a warm living animal, than in a dead carcase, cold, and under dissection.

The fat of an animal is different in its nature in different parts of the body. About the reins, and under the skin, it is solid: It is less so between the muscular fibres, or near the moveable viscera, such as the heart, the stomach, and the intestines. It is more copious in winter than in summer. It seems to contribute to the maintenance of heat in those regions in which it is placed, as is proved by a great variety of facts that have been collected by physiologists. It seems even to contribute to the nourishment of animals, as has been observed of the bear, the marmot, the dormouse, and of all those animals in general which are occasionally constrained to a long abstinence; for, on such occasions, their grease is, by degrees, melted and wasted away.

Before using grease in the making up of medicines, or before examining its chemical properties; it should be cut into pieces, and the membranes and vessels running through it separated from it: it is next to be plentifully washed with water, and melted with a little water in a

new

new earthen vessel. When the water is evaporated, and the boiling ceases, it may then be poured into another earthen vessel, and suffered to cool.

All the chemical properties of grease have not yet been examined. Nothing but the power of fire, of air, and of some re-agents, on this substance is known: Yet there is scarce any animal matter with which we need more to be well acquainted, in order that some judgement may be formed of the uses to which it is applicable, of which there is nothing certain hitherto known; as well as of the alterations which it is liable to suffer in living bodies.

The fat of any animal is liquefied by exposure to gentle heat, and congealed by cooling. When exposed to a strong heat, with concurrence of air, it diffuses a smoke of a poignant smell, which occasions tears and coughing; and it burns, when exposed to a heat sufficient to volatilize it. It leaves but very little residual coal. Grease distilled on a water-bath, affords a vapid water, of a light animal smell, neither acid nor alkaline, but liable to take, in a short time, a putrid smell, as also to deposit mucilaginous filaments. This phenomenon, which takes place in all water obtained from animal substances by distillation on a water-bath, proves that the water carries off with it some mucilaginous principle to which the alteration must be owing. Animal fat distilled in a retort, affords a phlegm which is at first aqueous, but becomes afterwards strong acid,—and oil that is partly liquid, partly concrete; and there remains a very small quantity of residual coal, which it is not easy to incinerate, and in which M. Crell found a small portion of carbonaceous phosphate. These products have an acid taste, nearly

pungent, and as strong as that of the sulphureous acid. The acid is of a peculiar nature, and has been carefully examined by Mr Crell ; but as it is exceedingly difficult to obtain it by distillation, that chemist employed a much surer and more expeditious process : we will speak of afterwards. The concrete oil may be rectified by repeated distillation, so as to become highly fluid, volatile, and penetrating,—in a word, so as to exhibit all the characteristics of a genuine, essential or volatile oil. Twenty eight ounces of human fat afforded Mr Crell twenty ounces, five drachms, and forty grains of fluid oil,—three ounces, three drachms, and thirty grains of sebaceous acid,—and three ounces, one drachm, and forty grains of bright coal, nearly in the same state with plumbum or carbure of iron, as was remarked by M. de Morveau. In this analysis, there were five drachms and ten grains lost : That loss must have been owing to the water in vapour, and the elastic fluids that were disengaged, as Mr Crell did not make use of any pneumatological apparatus.

Grease is very speedily altered, when exposed to the action of hot air : instead of continuing sweet and inodorous, as when fresh, it becomes strong and pungent in its taste, and absolutely rancid. This alteration appears to be a real fermentation, by which the acid is developed, and placed in a free state. Although this acid thus developed, seems to be of the same nature with the sebaceous acid, I consider not the change as owing solely to the oily part of the grease. The peculiar animal mucilage discoverable by a farther analysis, may concur in for its share in this alteration. The rancidity of grease may be corrected in two ways : water itself,

has been observed by Mr Pœrner, is capable of carrying off all the acid that it contains; alkohol, according to M. de Machy, has also the same power. This proves that the acid of rancid grease reduces it into a sort of saponaceous state, in consequence of which it becomes soluble in water and alkohol. Either of these fluids may be therefore confidently employed to restore rancid grease to its original state.

When grease is washed with a great quantity of distilled water, the fluid dissolves a gelatinous matter, the existence of which appears upon evaporation; but the grease still retains a certain portion of that matter intimately combined with it, on which its susceptibility of fermentation depends. Farther, the power of water over this animal substance has not yet been accurately ascertained.

Mr Crell, and the chemists of Dijon, have ascertained in what manner alkaline substances act upon animal fat. Pure alkalis have long been known to form a sort of soap with fat. Mr Crell, by treating that soap with a solution of alum, or aluminous sulphate, separated from it oil; and by evaporating the liquor, obtained sebate of potash. This last salt he distilled with concentrated sulphuric acid, which disengaged the sebatic acid. To separate from this acid, the sulphuric acid combined with it, Mr Crell advises to distil it again on a fourth part of the sebate of potash, which must be reserved for the purpose. To ascertain whether it be entirely purified from sulphuric acid, it may be assayed with acetite of lead. If the precipitate now formed be totally soluble in vinegar, it contains no sulphuric acid. The chemists of the Academy of Dijon employ a simpler process for

obtaining the sebatic acid : they melt the tallow, and, as it melts, throw into it quicklime : when this mixture becomes cool, they boil it in a large quantity of water : they next filtrate and evaporate the lixivium ; and, by this means, obtain calcareous sebate, which is brown and acrid. To purify this salt, it is calcined in a crucible, dissolved, filtrated, and mixed with a just proportion of water containing carbonic acid, in order to separate, by precipitation, the superfluous lime : it is after this evaporated ; and affords, by evaporation, a white salt, which is distilled with sulphuric acid, to disengage the sebatic acid.

This acid may likewise be obtained by distillation from the butter of cacao, the white of the whale, and probably all fixed vegetable oils. The following are its characteristic properties: It is liquid and white, and its smell very lively: it exhales white fumes; it is decomposable by fire, on which it becomes yellow, and affords carbonic acid: it converts blue colours to an high red: it unites with water in any proportion: with lime, it forms a crystallizable salt; with potash and soda, salts that crystallize in needles, and remain fixed in the fire. In union with the nitric acid, it dissolves gold; it acts upon mercury and silver; it precipitates nitrate and acetite of lead; it decomposes tartarite of potash, by precipitating the tartareous acidulum, or cream of tartar; it also decomposes alkaline acetites. If strongly heated with sulphuric salts, it disengages from them their acid in a sulphureous state; it precipitates nitrate of mercury and silver. A number of these properties had induced Mr Crell to think, that the sebatic acid might possibly be nothing else but a modification of the muriatic acid; but M. de Morveau observes,

observes, that, as it decomposes corrosive muriate of mercury, that property alone is sufficient to distinguish it from the muriatic acid.

Mineral acids, in a concentrated state, alter and burn grease. The sulphuric acid turns it brown ; the nitric acid gives it a lemon-yellow colour.

Sulphur combines very easily with fat, and forms with it a combination that has not been yet sufficiently examined.

Grease is capable of dissolving certain metals. It is united with mercury in the preparation known by the name of *mercurial pomatum*. To effect this union, all that is necessary is, to triturate the metal with hog's lard, for a considerable time. By this operation, the mercury is divided, attenuated, and united with the grease so intimately as to give it a slate colour, and no longer appears, therefore, in a metallic form. This union, however, is partly nothing but an extreme division ; or, at least, only a part of the mercury is dissolved by the sebacic acid ; for a magnifier shews the globules of the mercury still existing naked even in the best-prepared ointment.

The three metals most liable to alteration by fat, are, lead, copper, and iron. The oxides of these metals, too, combine with it very readily. This is what makes it so dangerous, to suffer meats that have been prepared with fat to stand for any time in copper dishes, or even in earthen dishes glazed with lead-glass.—In combinations of animal fat with the oxides of metals, it is observed, that the oxides pass easily, with the help of heat, into the metallic state. This is owing to the combination of

Fat.

the hydrogenous gas disengaged from the grease, with the oxigene of the oxides.

Almost all vegetable matters may be combined with fat. Extracts and mucilages render it, in some degree, soluble in water, or at least contribute to its suspension in that fluid. It combines with oils in any proportion, communicating to them a part of its own consistency.

These are all the chemical properties which this substance is known to possess. From considering them, it appears, that grease is nearly of the same nature with butter, being a fixed concrete oil, that owes to oxigene its solidity. This property has been imputed by all former chemists to an acid.

As to its uses in the animal economy ;—besides maintaining heat in the parts around which it is disposed, and giving an agreeable plumpness and roundness to the form, with a whiteness to the skin : Macquer thinks it likewise serves to absorb the acids when too copious in the animal body, and regards it as the reservoir of these salts. We are at least certain, that when too much acid is introduced into an animal body, it dissolves and melts the fat, by communicating to it, no doubt, a saponaceous character, and rendering it more soluble.

Excess, and, still more alterations of the fat, occasion fatal distempers in the animal economy, the symptoms and effects of which are far from having been yet examined with sufficient accuracy. Lorry has studied them with particular attention ; and has shewn, that there subsists a striking analogy between this substance and the bile. This analogy is in fact founded on the fatty nature of the bile, on the colour that it frequently assumes in bilious complaints, on the solution and absorption of the
the

the fat, in long continued affections of the liver ; on the cruel practice of enlarging and softening this viscus in some fowls, by dissolving their fat by long inaction combined with a dry and long continued heat, &c.

Fat is used as a seasoning, and is nourishing to people who have stout stomachs. In medicine, it is applied externally, as softening and calming ; it enters into the composition of ointments and plasters.

The marrow contained in the long bones, exhibits the same properties with the fat ; but it has not yet been analysed with such accuracy as might enable us to describe its characteristic properties.

C H A P. V.

Of the Bile and the Biliary Calculi.

THE bile or gall is a fluid, of a green colour, more or less yellowish, of a very bitter taste, and of nauseous smell, that is separated from the blood by glandular viscous, universally known by the name of the *liver*. In most animals, excepting insects and worms, it is collected in a membranous reservoir beneath the liver, called the *gall-bladder*. The human bile has been but little examined hitherto, on account of its being so difficult to procure a sufficient quantity of it. It is on the cow's that chemical experiments have been made.

Its consistency is nearly gelatinous or slimy: it runs into threads, like a tolerably clear syrup: when shaken it froths like a solution of soap.

When distilled on a water-bath, it affords a phlegm that is neither acid nor alkaline, but liable to pass, in a certain space of time, into a putrid state. I have often observed in this phlegm a singular property: I have found it to exhale a very discernible sweet smell, nearly the same with that of musk or amber. This experiment has been repeated a great many times in my laboratory. It succeeds best, in the distillation of bile that has been kept for some days, and is a little altered. When all the water that can be obtained from the bile on a water-bath is separated from it, it is then found to be in the
state

state of an extract, more or less dry, and of a deep embrowned green colour. This extract of bile attracts moisture from the atmosphere : It is very tenacious and pitchy ; it may be entirely dissolved in water. By distillation in a retort, it affords a yellowish alkaline phlegm, an empyreumatic animal oil, a good deal of ammoniacal carbonate, an elastic fluid mixed with carbonic acid, and hydrogenous gas : After this operation, there remains a coal of a considerable bulk, which it is easier to incinerate than any that we have yet mentioned.—According to M. Cadet, who, in the years 1767, presented to the Academy a most valuable Memoir on the Analysis of the Bile, this coal contains carbonate of soda, an animal earth, and a small portion of iron. It is to be observed, that the distillation of this substance must be slowly conducted ; for it swells considerably. As to the salt, which M. Cadet takes notice of, as existing in the coal of the bile, and thinks to be of the same nature with sugar of milk, it is easy to see, that such a matter could not resist the violent heat necessary to reduce the bile into a carbonaceous state.

In a temperature of between 178° , $15'$, and 223° , $15'$, of heat, the bile is speedily altered : Its smell becomes more nauseous ; its colour is altered and destroyed ; whitish mucilaginous flakes are precipitated from it ; it loses its viscidty, and soon after acquires a foetid pungent smell : When nearly putrefied, its smell becomes sweet, like that of amber. My pupil, M. Vauquelin, has discovered that the bile, after being heated on a water-bath, and thickened a little, will remain unaltered several months, in the same way as vinegar after being boiled. He has likewise discovered, that altered bile, which

1

exhales

exhales a foetid smell, and is of a brown colour, dirty, and turbid, loses its smell when heated ; and that some concrete albuminous flakes are then separated from it.

The bile dissolves very well in water. Its colour then changes to a yellow, which is darker or brighter according as the quantity of the water added is smaller or greater.

All the acids decompose it in the same way as soaps : the combination formed is a coagulum. This mixture, filtrated and evaporated, affords a neutral salt, formed of the acid that has been employed, and soda. This beautiful experiment, for which we are indebted to M. Cadet, proves the existence of soda in the bile. The matter that rests on the filter, in these instances, is thick, viscid, very bitter, and highly inflammable : its colour and consistency are not always the same, but vary with the nature of the acid employed, and the degree in which it is concentrated. I have observed, that the sulphuric acid gives it a deep green colour,—the nitric acid, a little concentrated, a bright yellow colour,—and the muriatic acid, a very beautiful light green ; but these colours vary greatly with the state of the bile, and that of the acids. This precipitate is a substance similar in its nature to resins : On burning coals, it swells, melts, and takes fire : in alcohol, it is totally dissolved ; and water precipitates it, like the resinous juices. The action of acids on the bile shews, therefore, that this substance is a true soap, formed of an oil nearly of a resinous nature, in union with soda. They prove also, that there exists in this animal liquor, a certain quantity of albuminous matter. That matter is the cause of the
coagulation

coagulation of the bile by fire, by acids, by alcohol: and that same principle likewise produces its putrefaction.

Neutral salts, mixed with the bile, prevent it from passing into a state of putrefaction.

Solutions of metals are decomposed by the bile, which they likewise decompose. The fixed alkali of the bile unites with the acid of the solution; and the coloured oil of the bile is precipitated in combination with the metallic oxide.

The bile combines readily with oils, and takes them up, as well as soap, from stuffs.

The fluid is entirely dissolved in alcohol; which separates from it the albuminous matter. The tincture of the bile is not decomposed by water; which shews this substance to be a true animal soap, equally soluble in aqueous and spiritous menstrua. *Æther* very easily dissolves it.

Vinegar decomposes the bile, as well as the mineral acids. The liquor, filtrated and evaporated, affords acetite of soda in regular crystals.

From these several facts it follows, that the bile is a compound, consisting of a good deal of water, a peculiar aroma, an albuminous mucilage, a particular concrete oil, and carbonate of soda. M. Cadet relates, that he found it to contain a salt, which he thinks to be of the same nature with sugar of milk; and the existence of that salt has been since confirmed by M. Van Bochaute. But it is probable, that this pretended saline substance is rather analogous to the bright, crystalline, foliated substance which has been found by M. Poulletier in the biliary calculi of the human body, and of which we are about to speak.

The

The bile, considered as it exists in the animal œconomy, is a juice which seems to promote digestion. Its saponaceous nature enables it to make oily matters combine with water. Its bitter taste shews that it stimulates the intestines, and promotes their action on aliments. Roux, a celebrated physician and chemist of the Faculty of Paris, whose premature death has been no inconsiderable loss to both these sciences, thought that the principal use of the bile was to carry off from the body the colouring part of the blood. It appears to be decomposed in the duodenum by the acids which almost always exist or are developed in the organs of digestion. It is certain, at least, that it is greatly altered, especially in colour, when it forms a part of the excrements. Skilful physicians, therefore, often draw very important inductions from an inspection of these matters, concerning the state of the bile in the intestines through which it is conducted, and of the liver by which it is separated.

The extract of the gall of the ox, and of several other animals, is used as an excellent stomachic. It supplies the deficiency, and quickens the inactivity of the bile: it strengthens the tone of the stomach, giving it, when weakened, new vigour to perform its functions. But it must be very cautiously used; for it is acrid and heating: it should always, therefore, be given in very small doses, especially to people whose nerves are delicate and easily irritated. Some ascribe peculiar virtues to the gall of fishes; but the notion has not been confirmed by experience, and it is therefore to be ranked among the too numerous class of those prejudices which disgrace the *materia medica*.

Of

Of the Biliary Calculi.

WHENEVER the bile of the human body is, by any cause, detained in the vesicle, especially when it is detained by spasmodic contractions, as in cases of melancholy, or hysterics, long-continued grief, &c. it becomes thick, and produces brown concretions, which are light, inflammable, and of a very bitter taste, and are called *biliary calculi*. These concretions are often very numerous; they distend the bladder, and sometimes fill it up entirely. They occasion violent hepatic pains, vomitings, jaundice, &c. I distinguish them into three varieties: Those which I include under the first variety, are brown, blackish, irregular, tuberculous, and seem to consist of lumps: Those of the second variety, are harder, brown, yellowish, or greenish, in concentric layers, and generally covered with a dry, uniform, grey crust;—their form is commonly angular and polyhædral: The third variety consists of white, ovoidal concretions, more or less irregular in their form, covered with a whitish crust, scarce ever equally thick all over, in layers of a spathose appearance, or in transparent, crystalline plates, generally radiated from the centre to the circumference.

The biliary calculi of the second variety have been examined by M. Poulletier de la Salle. He has observed them to be soluble in alcohol. On digesting some of them in strong spirit of wine, he remarked the liquor, at the end of a certain time, to be full of minute particles, brilliant and crystalline, and with all the appearances of a salt. The experiments which he made on this substance led him to suspect that it might be an oily salt, in some of its properties resembling the acid salt
with

with which, under the name of flowers of benzoin, we are already acquainted ; but it would appear that its nature is hitherto unknown. That philosopher could find this salt only in the biliary calculi of the human body, not in those of the ox. This very singular fact needs confirmation ; for M. Vauquelin and I have found a small quantity of lamellated matter in the biliary calculi of the ox.

M. Poulletier de la Salle's discovery has thrown light on some facts that were collected by the Royal Society of Medicine, concerning the stones formed in the gall-bladder. That Society received from their correspondents, some biliary calculi belonging to the third of the above-mentioned varieties, which had not then been described. They consisted of masses of transparent, crystalline plates, precisely of the same form with the matter discovered by M. Poulletier de la Salle. It even appears, that a large proportion of these crystals may be formed of the bile of the human body ; for the Medical Society have, in their collection of calculi, a gall-bladder entirely full of this transparent saline concretion. I have two others of the same kind, which I received from my colleagues, Messrs le Preux and Hallé. On examining these crystallized biliary calculi, I have discovered them to be of an oily nature, similar to the fat of a whale.

Soap, a mixture of æther and oil of turpentine, &c. have been proposed as fit solvents for these biliary calculi. It is worthy of observation, that they are not found in the gall-bladder of the ox, unless after dry seasons, and a scarcity of fresh forage, and disappear again in Spring and Summer, when the animal is supplied with plenty of green, succulent vegetables. Butchers

are well acquainted with this fact; they know, that between the month of November and the month of March these stones are found in the animals, and from March to November cease to be found. This is a sufficient proof of the power of the saponaceous juices of plants to dissolve the biliary calculi. Yet, it is not to be thought that medicines, however active and volatile, can be conveyed into the gall-bladder in sufficient quantity to act there with the same energy in dissolving the biliary calculi as in our experiments. In my opinion, the cessation of spasm, and consequently the dilatation of the biliary canal, is the true cause of the good effects of the æthereal mixtures that have been proposed by M. Durande, which I have elsewhere recommended to be made up without oil of turpentine;—with the more confidence, because it is evident that the oil is both very heating, and produces no useful effect but that of diminishing the volatility of the æther; and it has been already proved by some observations, that yolks of eggs, and, no doubt, many other substances, will serve the purpose as well, without the same unfavourable effects.

C H A P. VI.

Of the Saliva, the Pancreatic Juice, and the Gastric Juice.

ANATOMISTS and Physiologists have observed a great resemblance between the saliva and the pancreatic juice. The salivary glands, and the pancreas, are in fact precisely of the same structure; and the humours prepared by both these organs, appear to serve the same purpose. The human species and quadrupeds are the only animals that have saliva; at least, scarce any other animals have yet been found to possess salivary glands.

Chemists have not yet made any accurate experiments on either of these fluids. The only reason that can be assigned for this, is its being so very difficult to procure even a very small quantity of either. We know only, that the saliva is a very fluid juice, separated by the parotides and many other glands, which is constantly flowing into the mouth, but most copiously during the act of mastication. This humour appears to be of a saponaceous nature, and impregnated with air, which renders it frothy. When evaporated to dryness, it leaves but little residue: And yet concretions of the saliva are sometimes formed in the ducts by which it is conveyed into the mouth. It appears to contain an ammoniacal salt; for, lime and caustic fixed alkalis disengage from it a poignant urinous smell.—Pringle, from experiments
which

which he made, concluded the saliva to be very septic, and that it promoted digestion, by occasioning a commencement of putridity in the masticated aliments. Mr Spallanzani, and some other modern naturalists, think, again, that it possesses, in an eminent degree, the power of retarding and stopping putrefaction.

The gastric juice is separated from the small glands or extremities of the arteries that open into the internal tunic of the stomach. The œsophagus supplies also a small portion of it, especially in the inferior region : in this region, many birds are observed to have very large glands that open into very discernible excretory ducts. M. Vicq d'Azyr has carefully described those which appear in the stork, &c.

Some modern naturalists have been at great pains in examining the gastric juice. Messrs Spallanzani, Scopoli, Monch, Brugnatelli, and Carminati, some years ago, examined the properties of this liquor. They procured it from the stomachs of sheep and calves, by opening them after the animals had fasted for some time. They obtained it from carnivorous and gallinaceous birds, by making them swallow metal tubes, perforated with holes, and filled with very fine sponge. Mr Spallanzani examined the gastric juice of his own stomach, by making himself vomit, and by swallowing tubes of wood filled with different substances, that he might judge of the effects of the gastric juice upon each of them. Experiments with tubes had been before tried by M. de Reaumur. Lastly, M. Goffe of Geneva has had the courage to make himself vomit many times, by a certain process of his own, which consists in swallowing air.

these modern observations, the gastric juice appears to possess the following properties:

This juice is the principal agent in digestion: It converts the aliments into a sort of uniform soft paste: It acts on the stomach even after the death of the animal: It acts as a solvent; but, what distinguishes it from all other solvents, is, that it acts indifferently on animal and vegetable substances, without shewing any preference, or any stronger affinity with the one than with the other. Far from having a tendency to promote fermentation, it is one of the most powerful antiseptics known. As to its intimate nature,—it appears, from the experiments of the above-mentioned philosophers, to be different in different classes of animals. According to Mr Brugnatelli, the gastric juice of birds of prey and granivorous birds is very bitter, and consists of a disengaged acid, resin, animal matter, and common salt: That of ruminating quadrupeds is very aqueous, turbid, and saltish; it contains ammoniac, an animal extract, and common salt. M. de Morveau having digested some parts of the interior tunic of the stomach of a calf, in water, found it to display an acid character. Mr Spallanzani thinks this character to be owing to the aliments on which the animal feeds: he never found the gastric juice of carnivorous animals, acid; that of granivorous animals, he found always so. M. Goffe experienced the same thing in himself, after living long on raw vegetables. Mr Brugnatelli thinks, that the white matter of the excrements of carnivorous animals contains phosphoric acid; but M. de Morveau observes, that his experiments are not conclusive. Mr Scopoli found in it ammoniacal muriate; and suspects, that the muriatic acid is produced

by the operation of the vital powers of animals : But he has no decisive fact to support this opinion ; on the contrary, every fact concurs to evince that it proceeds from the aliments. Messrs Macquart and Vauquelin have found the gastric juice of the ox, the calf, and the sheep, to possess invariably an acid character ; but from the accurate experiments which they have made, it appears to derive this character from the phosphoric acid in a naked state. They have observed, too, that those juices alter and putrefy even very speedily. The gastric juice of carnivorous animals appears to possess antiseptic powers in a more eminent degree.

From all these facts taken together, it may be inferred,

1. That the gastric juice is as yet but imperfectly known :
2. That it appears to be different in different classes of animals, and modified according to the diversity of the aliments on which they live :
3. That we have yet no proof of its being a peculiar acid, or that we should acknowledge the existence of a gastric acid :
4. That its most remarkable properties are, a very extraordinary solvent power, which acts with sufficient energy even on bony and metallic substances, and is even said to be capable of attacking siliceous stones,—with a sort of indifference on what matter it acts, and the same affinity with all matters.

Its extraordinary antiseptic power, which it communicates to all bodies that are mixed with it, and which even stops putrefaction in substances in which that process is already begun, has been more attended to than any of its other properties. Messrs Carminarⁱ and Toggia, have applied the gastric juice t

Mr. Carminati has even administered it internally ; and they all agree with regard to its antiseptic powers. But the experiments of Messrs Maquart and Vaquelin above mentioned, which were made in my own laboratory, prove, that the gastric juice of ruminating animals possesses no such properties.

CHAP.

C H A P. VII.

Of the Humours or Animal Matters that have not yet been examined; such as Sweat, the Mucus of the Nose, the Cerumen, Tears, the Gum of the Eye, the Seminal Fluid, and the Excrements.

THERE are still many animal fluids and matters that have not been examined: And therefore, rather with a view to engage young physicians in such new and useful researches, than to explain their nature, we shall say something of the humour which transpires by the pores,—the sweat, the mucus of the nostrils, the cerumen of the ears, the tears, the gummy matter of the eyes, the seminal fluid, and the excrements.

Physicians have discovered a great resemblance between the humour which transpires by the pores, and the urine. They know that on many occasions one of these excretions supplies the place of the other; and are therefore naturally led to consider the vaporous fluid which transpires by the pores as of the same nature with urine. In the practice of medicine, its qualities are observed to be subject to variation: Its smell is faint, aromatic, alkaline, or sour; its consistency, sometimes glutinous, thick, tenacious; and it leaves a residue on the skin: It frequently communicates a low colour, of various shades. I ha

24 *Sweat, Mucus of the Nose, Cerumen, Tears, &c.*

to communicate to linen, and woollen stuffs, a sparkling blue colour. M. Berthollet affirms, that sweat reddens blue paper; and observes, that this phenomenon takes place chiefly on parts affected with the gout. He supposes it to contain phosphoric acid. It has hitherto been found impossible to collect a sufficient quantity of this excrementitious humour, for examining its properties carefully. A great many experiments, therefore, remain to be made on this matter, which only accidental and peculiar circumstances can enable naturalists to undertake and prosecute.

The humour prepared by the membrane of Schneider, which is thrown out of the nose by sneezing, highly merits the attention of physicians. It is a sort of thick mucus, either white or coloured; in certain affections, especially in catarrhs, more or less fluid or consistent. It seems to be a mucous, alkaline substance, which becomes thick in consequence of absorbing oxygen from the atmosphere.

We are unacquainted with the nature of that greenish yellow, or brown matter which gathers in the auditory canal, becomes thick, and is, from its consistency, known by the name *cerumen*. It is very bitter: it seems to be of a resinous nature: it is known to become sometimes sufficiently concrete to close up the auditory canal, and hinder sound from entering it freely: it seems to be somewhat of the same nature with the inflammable matter of the bile.

We know more of the tears which are prepared in a certain gland, situated near the external angle of the socket of the eye, and are designed by nature to maintain

tain the moisture and suppleness of the exterior parts. This liquor is clear, limpid, and discernibly saltish; it sometimes runs very copiously: In the ordinary state of the human frame, it runs by degrees into the nostrils, and seems to serve the purpose of moistening the mucus. Most of the authors that have spoken of this liquor of tears, particularly Pierre Petit, a physician in Paris, who about the end of the last century, published a treatise on tears, consider them as being nearly pure water. We have found them to contain a particular mucilage that grows thick by absorbing oxigene, muriate of soda, and soda in a caustic state; after that, this humour becomes similar to the mucus of the nose with which it mixes.

The chemical nature of the seminal fluid has not been more particularly examined than that of those fluids above-mentioned. From the very few observations that have been made upon it, it appears to be nearly of the same nature with animal mucilages, to be liable to become fluid either by cold or heat, and to be reducible by the action of fire into a dry friable substance.

On this head, anatomical and microscopical observations have gone much farther than chemical experiments. From these it appears, that the seminal fluid is a sort of ocean, with small round bodies swimming about in it with great rapidity of motion. These are, by some considered as living animals intended for the reproduction of the species, and, by others, as organic particles which unite to produce a living animal. A late observer has likewise discovered, with the microscope, crystals that are formed during the cooling and evaporation of the seminal fluid. It must be confessed, however, that these fine experiments have as yet contributed

not

nothing to the advancement of the science, and have only given ground for some ingenious hypotheses.

M. Vauquelin has given in the *Annals of Chemistry*, (April 1791), a memoir on the human semen : the following are the new facts which it contains.

1. This substance has a faint odour, a sharp, and somewhat astringent taste ; its weight is greater than that of water.

2. To ascertain if the air be the cause of the liquefaction which takes place in this fluid soon after it has been emitted, he exposed equal quantities of it in the open air, and in close vessels, which completely excluded this fluid. As liquefaction took place in both portions in the same manner and in the same time, he was thence led to conclude that neither air nor the substances dissolved in it produced this effect.

3. When some feminal liquor was allowed to liquefy in a small glass ball, that terminated in a very narrow tube, it acquired no increase of bulk. This was easily ascertained by marking the place to which the fluid rose. He seems to have had some suspicion that this phenomenon was owing to caloric.

4. When some of this fluid was exposed for some days to the air in a small capsule, long, transparent crystals were deposited in it, of the shape of a prism with four sides terminated by pyramids with four faces. According to the experiments of this author, these crystals, which had been announced before in the *Journal de Physique*, are a very pure phosphate of lime.

5. After exposure to the air for some time, there is formed on the feminal liquor a very thick pellicle, which is set with opaque white points. These points are of
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the same nature with the former crystals, and differ from them only in wanting transparency.

6. If the air in which the seminal fluid is exposed be moist, it does not become quite dry, it continues soft and ductile. But, before arriving at this state, it suffers several changes which the author has described with care. It takes a yellow colour; becomes acid; crystals are formed in it; and at last it exhales the smell of putrid fish. If, on the contrary, the air be warm and dry, the semen dries instantly, becomes hard and brittle like horn, and during this desiccation it loses $\frac{2}{3}$ of its weight.

7. The seminal liquor exhibits strong proofs of the presence of an alkali, which are owing to the soda that the author has discovered in it.

8. Water at whatever temperature, that is from the freezing to the boiling point, does not dissolve semen that has not been previously liquefied: but after it has been liquefied, water combines with it at every temperature. This, M. Vauquelin observes, denotes some change either in the texture or organization, or in the internal nature of the semen, during its liquefaction.

9. All the acids, excepting the oxygenated muriatic acid, dissolve the seminal liquor very readily. The alkalies cannot disengage it afterwards in a solid state. The oxygenated muriatic acid, instead of dissolving it, reduces it to white flakes that afterwards become yellow, if the acid be added in large quantity. The urine, by means of its disengaged acid, likewise dissolves the seminal fluid.

10. The seminal fluid, when fresh, does not decompose; the barytic salts, whilst it decomposes them after

long exposed to the air. This effect is produced by the carbonic acid of the atmosphere, which is absorbed by the soda contained in the semen, and which enables it to decompose the barytic salts. All the calcareous, magnesian, and aluminous salts are decomposed by semen, because soda has a stronger attraction for the acids than these earthy matters possess. The metallic salts are still more readily decomposed by this substance.

11. Dried semen, when distilled, furnished ; 1. Some drops of water ; 2. An elastic fluid, composed of carbonic acid, and carbonated hydrogenous gas ; 3. An empyreumatic oil ; 4. Ammoniacal carbonate ; 5. There remained a very light coal in the retort.

12. To ascertain the proportions of the substances which the former experiments had discovered in the semen, M. Vauquelin took 40 grains of dried semen, which corresponded to 400 grains of this fluid when fresh, since it loses $\frac{1}{5}$ of its weight by drying, and heated them in a crucible of very pure white clay. This substance swelled, emitted yellowish ammoniacal fumes, and was converted into coal. When a strong heat no longer disengaged any thing from it, the crucible was removed from the fire, the coal which it contained was lixiviated, and the lixivium evaporated in the air furnished 8 grains of carbonate of soda, recognisable by every property of this salt. The lixiviated coal was again exposed to the fire ; it burnt readily, and there remained 12 grains of a white cinder that had no taste, that did not dissolve in water, and that melted at the blowpipe into an opaque globule that shed a phosphoric light, whilst it continued in fusion. This substance dissolved in acids ; its solution was precipitated in white
flakes

flakes by all the acids and by limewater. A solution of it in the muriatic acid, evaporated to dryness, and afterwards treated with strongly rectified spirit of wine, was divided into two portions. One of these dissolved in alkohol, furnished with the oxalic and the sulphuric acid, precipitates of oxalate and sulphurate of lime, and with potash, pure lime. The other portion which remained of a thick consistence, was melted at the blow-pipe into a transparent glass, soluble in water, and the solution of which precipitated lime water and reddened blue vegetable colours. This analysis proves that this last substance is composed of lime and the phosphoric acid like the basis of bones.

From the preceding experiments it follows that the human semen is composed,

	Parts.
1. Of animal mucilage	6
2. Of soda - -	1
3. Of phosphate of lime	3
4. Of water -	90 in the 100

The aliments which animals swallow, contain a great quantity of matter that cannot afford them nourishment, and is evacuated from the intestines in a solid form. The excrements are coloured by a portion of the bile, which they carry off with them. The foetid odour which they exhale, is owing to their having begun to putrefy in their passage through the intestines. No chemist but Homberg has examined these matters. He observed the phlegm obtained from the excrements, by distillation on a water-bath, to have a nauseous smell: by washing and evaporation, he obtained from them a salt which melted like nitre, and kindled voluntarily in close vessels.

This matter, by distillation in a retort, afforded the same products as other animal substances. From putrid excrements he obtained an oil destitute of colour and smell, which did not gratify his expectations of seeing mercury converted by it into silver.

It is to be observed, that the fecal matter examined by Homberg, was that of men fed upon coarse bread and Champagne wine ; which had been required as a condition necessary to the success of the achemical experiment he had been directed to make. The food must doubtless peculiarize, in some degree, the nature of the excrements, as these are nothing but the residue of the food. An exact and careful analysis of the excrementitious matters of different classes of animals, is one of the most certain means of discovering the phenomena of digestion. Several celebrated chemists are at present engaged in this pursuit.

C H A P.

C H A P. VIII.

Of Urine.

URINE is a transparent, excrementitial fluid, of a lemon-yellow colour, of a peculiar smell, of a saline taste, separated from the blood by two glandular viscera that are called the reins, and from these conveyed into a reservoir universally known by the name of the bladder, in which it remains for some time : it is a sort of *lixivium* impregnated with the acrid matters of the animal humours, which, if too long retained in the body, might obstruct and disorder the functions of the system.

Urine is a solution of a great number of salts, and two extractive matters. It varies in quantity and in qualities, according to circumstances. That of the human species, which we propose to examine more particularly, differs from the urine of quadrupeds. Among other classes of animals the differences are still greater. The state of the stomach, and particularly the state of the humours, produce an infinite diversity of changes on this fluid ; to ascertain and estimate which, a long series of experiments would be requisite, which have, as yet, only been pointed out as necessary. Here, therefore, we shall speak only of human urine as it is emitted in a state of health.

This fluid is, by good physicians, distinguished into two sorts. The one called *crude* is off soon after meals :

meals : it is clear, and almost entirely without taste or smell : it is far from containing so many different principles as the other. It, again, is called urine of the blood, or of concoction, and is not emitted till after digestion : it is separated from the blood by the reins ; whereas the other species appears to filtrate, in part, from the stomach and the intestines, directly into the bladder, through the cellular tissue, or the absorbent vessels.

The state of the health, and more especially the disposition of the nerves, modify the urine in a singular manner. After hysteric or hypocondriac fits, it flows copiously ; it is then inodorous, insipid, and colourless. Diseases of the bones and joints have considerable influence on this animal lixivium. It often deposits a great quantity of matter, apparently earthy, but which, as we shall hereafter shew, consists of lithic acid, and calcareous phosphate. The sediment of the urine of those who have the gout is of this sort. Physicians, particularly Herissant and Morand, have observed, that when the bones are altered or softened, the urine deposits a good deal of this matter. It even appears, that the urine of people in a good state of health deposits a quantity of this matter, which constitutes the basis of bones ; which is probably all of it that is formed in the body above what is requisite for the nutrition and reparation of those organs.

Many of the articles of food communicate some peculiar properties to the urine. Turpentine and asparagus give it, the former a smell of violets, the latter a very foetid smell. The urine of people of weak stomachs retains a smell of their food : bread, garlic, or to

soup, and all vegetables, communicate each its peculiar smell to the urine. From these particulars, it appears, that an observation of the phenomena which urine exhibits, may be of considerable use to the physician in the practice of his art. We must, however, beware of imagining that, from simple inspection of the urine, it is possible for the physician to judge of the disease and sex of the sick person, and of the proper remedies ; as some empirics pretend to do.

The urine of the human species, considered with respect to its chemical properties, is a solution of a great many different substances. Some of these are salts, similar to those of minerals, and, as Macquer thinks, proceed from the aliments, without alteration. Others of them are matters of the same nature with the extractive principles of vegetables : And lastly, some appear peculiar to animals, and even to urine ;—at least, have not been found in any notable quantity among the products of the other kingdoms of nature, nor even in any other animal substances but urine. After explaining the processes employed to extract these different matters from urine, we shall give the history of such of them as are peculiar to the fluid, and therefore have not before come under our notice.

Urine used to be considered as an alkaline liquor, or *lxivium* ; but M. Berthollet has remarked, that it always contains a greater quantity of phosphoric acid than of any other salt, and reddens the tincture of turnsole *. This physician has observed, that the urine of gouty people always contains less acid salt than that of people

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* Coldevillars had before asserted, in his *Course of Surgery*, that urine constantly reddened the tincture—

in a state of perfect health ; and that, during the fit of the gout, their urine is still less acid than at other times. Hence he conjectures, that in gouty people the phosphoric acid is not evacuated by the urine, as in people in perfect health ; that it loses its way, (if the expression may be here used) and, being conveyed to the joints, there occasions irritation and pain. This excess of acid in the urine appears to maintain in solution in it, a quantity of calcareous phosphate.

Scheele thinks the acid of urine not to be altogether phosphoric acid, but partly the same with the acid of the calculus in the human bladder, which we call the lithic acid. This acid being susceptible of concretion and crystallisation, forms according to that celebrated chemist, the red crystals that are deposited in urine, as well as the brick-coloured precipitate observed in the urine of feverish persons. The tophaceous concretions on the joints of gouty persons, appear to be of the same nature with the calculus, that is, to consist chiefly of lithic acid.

Fresh urine, distilled in the water-bath, affords a large quantity of a phlegm which is neither acid nor alkaline, but soon putrefies. As this phlegm contains nothing peculiar, urine is commonly evaporated by naked fire. In proportion as the water, which composes more than seven eighths of this animal humour, is evaporated, the urine assumes a brown colour : there is separated from it a pulverulent matter of an earthy appearance, which has been taken for calcareous sulphate, but is really a mixture of this salt with calcareous phosphate and lithic acid. This salt is of the same nature with the basis of bones, and the matter of the calculus in the bladder.

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When the urine has acquired the consistency of clear syrup, it is then filtrated, and removed into a cool place. In the course of a certain time, it deposits saline crystals, consisting of muriate of soda, with two peculiar saline substances. These last salts are known by the name of *fusible salts, native salts of urine, alkaline phosphates, &c.*: their properties shall be examined in the following chapter. Several different quantities of those crystals may be obtained, by repeated evaporation and crystallisation. In these successive evaporations, a certain quantity of muriate of soda and muriate of potash is crystallised. When the urine ceases to afford saline matter, it remains in the state of a very thick brown fluid, a sort of mother water, holding in solution two peculiar extractive substances. By evaporating this fluid to the consistency of a soft extract, and treating the residue with alcohol, Rouelle the younger discovered, that one portion was soluble in alcohol, but another suffered no solution in it. The first of these matters he has called *saponaceous matter*; the second *extractive matter*.

The saponaceous substance is somewhat saline, and susceptible of crystallisation. It is difficult to make it dry; and, even when dry, it attracts moisture from the atmosphere. In the retort, it affords a quantity of ammoniacal carbonate equal to more than half its weight, a little oil, and some ammoniacal muriate: Its residue gives a green tinge to syrup of violets.

The extractive substance, which is soluble in water, though not in alcohol, dries as easily in the water-bath as the extracts of plants: it is brown,* and not so liable to deliquiate as the former salt: it affords, by distillation, all the usual products of animal matters. Such, accord-

ing to Rouelle, are the characteristic and distinctive properties of these two substances which form the extract of urine. To these particulars we may add, that this celebrated chemist obtained from an ounce to an ounce and a half of extract out of a pint of urine of concoction; whereas, the same quantity of crude urine afforded him only one, two, or three grains.

If, instead of separating this extract of urine into two distinct matters by alcohol, we distil it altogether by naked fire,—it affords a good deal of ammoniacal carbonate, an animal oil, and a little phosphorus. Its coal contains a little muriate of soda, or common salt. This analysis of urine shows, therefore, that the fluid consists of a large proportion of water, both phosphoric acid and lithic acid in a disengaged state, muriate of soda, sulphate of lime, calcareous phosphate, phosphate of soda, and ammoniacal phosphate, and two peculiar extractive matters which colour the fluid. With respect to the dark colour which it acquires in various diseases, especially in all cases in which the bile is affected, I have discovered that it is owing to the oily matter of the bile; and that the extract of this urine, thus altered in colour, when dissolved by alcohol, (that portion of it which is soluble in this menstruum) is precipitated from it by water.

Urine, exposed to air, is altered the sooner, the hotter the atmosphere. Sediments are first formed in it simply by cooling: several saline matters are crystallised at the surface, and at the bottom of the liquor; and among these, generally, a reddish salt, which appears to be of the same nature with the calculus in the bladder. Nobody has observed the spontaneous alterations of this excremential fluid with more attention than my colle

M. Hallé. In the decomposition which urine suffers when left to itself, he has distinguished several different periods at which sediments or crystals of a different nature are found deposited; as also the changes which the fluid undergoes, in consequence of depositing these sediments and crystals. We cannot enter here into a detail of these particulars, relative to the changes of the fluid, and the matters which it deposits; but the reader may find them accurately described in a valuable *Memoir*, inserted among the *Memoirs* of the Royal Society of Medicine for the year 1779. We shall only mention here the principal alterations which urine suffers. Soon after it becomes cool, its smell alters, becomes more pungent and even ammoniacal; its colouring part is changed, and separated from the rest of the liquor: at length the alkaline smell goes off, and is succeeded by another, not so pungent, but more disagreeable and nauseous: at last the decomposition is completely effected. **Rouelle**, the younger, has observed, that crude serous urine does not putrefy so fast; that its colour, when it is altered, is greatly different from that of urine of concoction; and that at last it is covered over with mouldiness, like the juices of vegetables, and the solutions of animal jelly. **M. Hallé** has observed some urines to become highly acid before passing into a state of putrid decomposition. Urine evaporated, after being suffered to putrefy for a year or more, affords fusible salt, as well as fresh urine: but it contains much more phosphoric acid in a naked state, and effervesces with ammoniacal carbonate: a part of its ammoniac has been volatilized by the putrefaction. When it is evaporated, the salt that is deposited on the sides of the vessel is highly acid;

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and

and to obtain a greater quantity of it, Rouelle, the younger, directs to add ammoniacal carbonate, till the effervescence entirely cease, and the acid be completely saturated.

Quicklime and dry fixed alkalis instantaneously decompose the saline principles contained in urine. Nothing more is necessary, than to pour caustic potash or soda, or to cast quicklime—into fresh urine, in order to make it yield an insufferable putrid ammoniacal smell. It is by decomposing the ammoniacal phosphate, that these substances produce such a smell. M. Berthollet has discovered, that lime-water produces, in fresh urine, a precipitate from which phosphorus may be obtained. This phenomenon is occasioned by the union of the lime-water with the excess of phosphoric acid : And the precipitate is formed, 1. Of the calcareous phosphate that naturally exists in urine, and was maintained in solution only in consequence of there being an excess of phosphoric acid ; 2. Of new calcareous phosphate, formed by the union of the lime that has been added with the acid that was before in a state of freedom. M. Berthollet having observed, that caustic ammoniac likewise precipitates calcareous phosphate from urine, by neutralizing the naked phosphoric acid by which that salt was held in solution, remarks, that the weight of this precipitate, compared with that which is produced by lime-water, indicates the quantity of naked phosphoric acid contained in the urine ; for, in fact, the ammoniacal phosphate formed on this occasion remains dissolved in the fluid, whereas the calcareous phosphate produced by lime-water is precipitated, as insoluble, at the same time with the calcareous phosphate naturally existing in the urine ;

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The acids produce no effects on fresh urine : but they speedily deprive putrid urine of its smell ; and they, in the same manner, destroy the smell of the sediments which it deposites in that state. Urine when heated, instantly dissolves the sediment that had taken place in consequence of its cooling.

Urine decomposes many solutions of metals. Lemery has made known, under the name of *the rose-coloured precipitate*, a magma, of a rose colour, that is formed by pouring the nitric solution of mercury into urine. That precipitate is formed partly by the muriatic acid, and partly by the phosphoric acid contained in the fluid. M. Brongniart has observed, that sometimes this preparation takes fire by friction, and that it burns with rapidity on burning coals,—phenomena which he ascribes to its containing a small portion of phosphorus.

Such is the state of our present knowledge concerning the chemical properties of urine. Much yet remains to be done, before we can obtain all the information concerning this matter that analysis is capable of furnishing. The several sediments that have been observed in urine, and so accurately distinguished by M. Halle, should be analysed : The red or transparent saline concretions that are formed in it, and have been taken by Scheele for lithic acid, should also be analysed ; and in like manner, the copious sediment which urine affords after fits of the gout, from persons afflicted with stone, &c.

We shall, however, in the following chapter, examine the several saline products that urine affords, with the properties of which physicians ought to make themselves well acquainted.

C H A P. IX.

Of the Ammoniacal Phosphate, the Phosphate of Soda, and the Stone in the Bladder, or the Lithic Acid.

WE have seen, that urine contains certain peculiar salts. Those are combinations of phosphoric acid with ammoniac, soda, lime, and the acid base of the stone in the bladder. Continuing to use, for these substances, the methodical denominations already mentioned, we shall successively examine the ammoniacal phosphate, the phosphate of soda, and the lithic acid. As to the calcareous phosphate, we shall describe its properties under the article *Bones*.

The salt obtained from evaporated urine by cooling and rest, has been called in general *fusible salt*; because, as we shall immediately see, it melts in the fire: it has been also called *essential salt of urine*, *microcosmic salt*. In this primary state, it is a mixture of ammoniacal phosphate, of muriate, and of phosphate of soda, contaminated with an extractive matter. Several chemists, particularly Margraf, have been of opinion, that, to avoid the mixture of marine salt, the urine must be suffered to putrefy; and the marine salt is, by the putrefaction of the urine, changed into phosphate. That opinion has been since proved to be false: 120 pints of fresh urine afford, according to Margraf, about four ounces of ammoniacal phosphate, and two ounces of phosphate of soda.

It

It is not easy to effect an entire separation of these substances of which the soluble salt consists, that is obtained by a first crystallisation, and was considered by Schockwitz, Le Mort, Boerhaave, Henckel, and Schloffer, as a single salt. To accomplish this separation, it has been recommended to dissolve the salt in hot water, to evaporate, and crystallise it. But Rouelle the younger, and the Duke of Chaulnes, are the only chemists that have mentioned a very great and uncommon difficulty with which the process is attended : Most of the salt is carried off by the heat of the solution and evaporation, and about three fourths of it are lost. The Duke of Chaulnes has given a process for purifying it with as little loss as possible : which consists in filtrating the solution, and leaving it to cool in close-stopped vessels. By either of these manipulations, there is obtained, first, a salt crystallised in rhomboidal tetrahædral prisms, very much compressed, which has been considered as pure ammoniacal phosphate; and, above these first crystals, another salt, in cubes, or rather oblong square tables, very different from the former salt in shape; this again has been taken for phosphate of soda. This last salt, as has been remarked by Rouelle the younger, may also be separated, by taking off the efflorescence that gathers on the former salt, which is liable to no such alteration. But each of these salts is a treble salt; the first is formed of a large proportion of ammoniacal phosphate, and a little phosphate of soda: in the second the order of composition is inverted.

Of Phosphate of Ammoniac and Soda.*

I DISTINGUISH by this name the salt that crySTALLISES first pure, which has been taken for phosphate of ammoniac purified and crySTALLISED first during the purification of the fusible salt. It is in the form of rhomboidal tetrahædral prisms, much compressed, and generally truncated in their length, and at the angles: in consequence of these circumstances, the prisms are, in some measure, hexagonal. There are likewise often enough found, according to M. Romé de Lille, from whom I take my description of this salt, longitudinal segments of the prisms, of which segments the side that lies on the capsule is the broadest; it is also rhomboidal, and intersected by two diagonal lines, crossing at the middle. The tetrahædral or octahædral form ascribed to it, appears only while this salt yet retains muriate and phosphate of soda. The power of communicating the octahædral form seems to belong peculiarly to the muriate of soda; for, when the former salt is dissolved in urine, and the liquor exposed to the sun, regular octahædral crystals are obtained in the course of a few days. The taste of phosphate of ammoniac and of soda is at first fresh, and afterwards urinous, bitter, and pungent: When heated with the blow-pipe on a burning coal, it swells, diffuses a smell of ammoniac, and melts, into a deliquescent vitreous globule: When distilled in a retort, the heat disengages from it some very pungent and

* In a methodical nomenclature of triple salts, the place of the words which design their bases ought to indicate their reciprocal proportions: the first-named base is the most abundant. F.

and caustic ammoniac : the residue is a very fixed and fusible transparent glass, which corrodes the retort. Margraff says, that it is soluble in two or three parts of distilled water, and exhibits the properties of an acid. Rouelle affirms it to be a deliquescent. M. de Morveau, again, thinks, that with the help of a good fire, it may be reduced into an unalterable vitreous state. M. Proust has discovered, that this vitreous residue is a combination of phosphoric acid with a peculiar matter which he does not seem to have known, and which is nothing but phosphate of soda, as appears from the researches of several modern chemists. But it is to be observed, that this glass, which still retains a portion of phosphate of soda, is always opaque, or exceedingly liable to become so : it is only the pure artificial ammoniacal phosphate that affords a very transparent glass, like the phosphoric acid alone.

Phosphate of ammoniac and of soda is not liable to be altered by the action of air.

It appears to be very soluble in water, only five or six parts of cold water being requisite to maintain it in solution. Hot water, at the temperature of 170 degrees, decomposes it, and even volatilizes a part of its acid.

Phosphate of ammoniac and of soda acts as a flux on siliceous earth, aluminous earth, barytes, magnesia, and lime : But these vitreous compounds are owing to the phosphoric acid, and to the phosphate of soda ; for the ammoniac is disengaged before the fusion takes place.

Lime, and the two fixed alkalis, in a pure state, decompose ammoniacal phosphate, and separate the ammoniac. Lime-water, poured into a solution of this salt, produces

produces a white precipitate, which can be nothing but calcareous phosphate. Alkaline and earthy carbonates likewise decompose it, and separate the ammoniac in the state of ammoniacal carbonate.

The effects of the mineral and vegetable acids on phosphate of ammoniac and soda, have not as yet been examined with sufficient care. It must depend on the various elective attractions which exist between the phosphoric acid and its alkaline bases. We shall treat of it when we come to treat of that acid.

The same is the case with respect to the alterations which phosphate of ammoniac and of soda suffers from metals, and metallic oxides; for those alterations depend entirely on the phosphoric acid.

Phosphate of ammoniac and of soda, treated with coal, affords phosphorus. Bergman proposes the use of it as a flux, in assays with the blow-pipe.

Of Phosphate of Soda and Ammoniac.

WE have described the manner in which phosphate of soda and ammoniac is obtained. It was considered at first as a pure phosphate of soda, but always contains a little phosphate of ammoniac. It will be proper to give the dates of the different discoveries concerning it, before we proceed to examine its properties.

Hellot, in the year 1737, seems to have been the first who mentioned it; but he took it to be sulphate of lime. Haupt, in the year 1740, gave a better account of it, under the name of *sal mirabile perlatum*. Margraf described it in the year 1745. Pott made mention of it in the year 1757, but, like Hellot, took it for sul-

hate of lime. Rouelle, the younger, examined it in the year 1776, and gave it the name of *fusible salt*, with base of *natrum*. All these chemists perceived this salt to be different from the last, chiefly by observing, that it did not afford phosphorus with coal. But Rouelle has distinguished its properties better than any of the rest. According to him, its crystals are flat, irregular, tetrahædral prisms, with one of the extremities dihædral, and consisting of two rhomboids, the other adhering to the base. The four sides of the solid are two alternate irregular pentagons, and two oblong rhomboids, cut slope-wise.

Phosphate of soda and ammoniac exposed to heat in a crucible, melts, and affords a white, opaque mass. When heated in a retort, it affords nothing but phlegm, without any acid or alkaline character; and the residue is an opaque glass, or frit.

In the air, this salt effloresces, and falls all down into dust.

It dissolves readily in distilled water, and crystallises by evaporation: the solution turns the syrup of violets green.

Calcareous nitrate decomposes it: a precipitate of calcareous phosphate is formed; and the supernatant liquor affords nitrate of soda.

This salt is equally liable to be decomposed by the nitric solution of mercury. It forms a white precipitate, which, when distilled in a retort, affords a little reddish sublimate, and some running mercury, and leaves in the bottom of the retort, an opaque white mass, adhering to, and combined with the glass. This mercurial precipitate forms again phosphate of soda, when boiled

with a solution of carbonate of soda, and leaves the mercury in the state of a brick-red powder. Such are the facts which the younger M. Rouelle discovered concerning this salt. M. Proust, being engaged by that celebrated chemist, whose pupil he was, in a new examination of this matter, made a great many experiments upon it; of which the following are the principal results. On lixiviating the residue of phosphorus, formed from fusible salt of the first crystallisation, from which he had obtained no more phosphorus but what was equal to an eighth part of the weight of the salt; the lixivium afforded, by evaporation in the open air, parallelogrammatic crystals, an inch in length, and in the proportion of five or six drachms to the ounce of the fusible salt from which the phosphorus was formed. It is to be observed, that this proportion would not be so great, were it not for the water that enters into the crystals. This substance melts in the fire into an opaque glass: it communicates a green colour to flame: it effloresces in the air: it decomposes nitrates and muriates, by disengaging the acids: it forms glasses with earthy matters, by fusion: it saturates alkalis, like an acid. From these facts M. Proust concluded this saline substance to be different in nature from all that he was before acquainted with,—to be combined with phosphoric acid, and ammoniac in ammoniacal phosphate,—and to form, with soda, Rouelle's *fusible salt with a base of natrum*. He observed, that it performed the functions of an acid, and compared it to the boracic acid. On this idea, M. Proust made new experiments on the fusible salt with a base of *natrum*, obtained by Rouelle's process, above described.

According to him, lime decomposes this salt ; having a greater affinity than soda with the peculiar substance which performs in it the functions of an acid. Lime-water poured into a solution of this salt, produces a precipitate ; and the soda is left in solution, in a pure caustic state.

The mineral acids, and even distilled vinegar, decompose it, in a way directly contrary to this. Rouelle supposed, that the sulphuric and the nitric acids did not act on this salt, because they produced upon it no visible change ; but M. Proust, on mixing the sulphuric, the nitric, the muriatic, and the acetous acids, with a solution of *fusible salt with a base of natrum*, observed, that although there was no precipitate formed in these mixtures, yet the liquors, when evaporated and cooled, afforded sulphate and nitrate, muriate and acetite of soda : which proves, 1. That the salt has been decomposed by these acids : 2. That it contains soda, as had been before shewn by the younger Rouelle. As to the separate substance which was before in union with the soda, it is plain that it remains in solution in the liquors, together with the new neutral salts. M. Proust distinguished it very plainly in the mother-water, obtained after the mixture of vinegar with the solution of the fusible salt, and the crystallisation of the acetite of soda. By pouring on that mother-water, eight or ten times its bulk of alcohol, the last portions of the neutral acetous salt are dissolved, and a magma is formed, which must be washed with a new quantity of alcohol, and then dissolved in distilled water. This solution of the magma, when evaporated in the open air, affords parallelogrammatic crystals, precisely like those which are obtained by washing the

the residue of phosphorus, formed from fusible salt of the first crystallisation, from urine. It is therefore, according to M. Proust, a peculiar substance, of the same nature with the boracic acid, which saturates the soda, in fusible salt with a base of natrum. This discovery seems to explain the reason why this salt does not afford phosphorus. To these particulars M. Proust added, that it was a new substance, which existed always in true fusible salt, or phosphate of soda and of ammoniac, and communicated to the phosphoric acid the property of melting into a glass; and for this reason, I gave it, in the first edition of this work, the name of *the base of phosphoric glass*. But M. Morveau has since been convinced, on sufficient evidence, that the pure phosphoric acid, obtained from phosphorus by deliquescence, and consequently containing none of that substance, is fusible, by heat alone, into a solid and permanent glass. This series of experiments which M. Proust made with great care, and of which the results are particularly striking, induced Bergman to consider this substance as a peculiar acid: He gives a history of it in the second edition of his Dissertation on Elective Attractions, under the name of *acidum perlatum*, derived, no doubt, from the denomination given by M. Haupt, in the year 1740, to fusible salt with a base of natrum. M. de Morveau has introduced it, as a distinct article, into his Chemical Dictionary, under the name of the *ouretic acid*, from the Greek name of urine, which affords it. But, since M. Proust's experiments, Bergman's Dissertation, and the compilation of M. de Morveau's article, M. Klaproth has published, in M. Crell's Journal, an analysis of *fusible salt with a base of natrum*; which annihilates this pretended

pretended peculiar acid, and shews it to be nothing but phosphoric acid in combination with soda. Mr Klaproth discovered this truth by such another experiment as that of the younger Rouelle. On precipitating the solution of *fusible salt with a base of natrum*, by calcareous muriate or nitrate; the precipitate, which Rouelle had before mentioned as analogous to the base of bones, actually affords phosphoric acid by means of sulphuric acid. Mr Klaproth adds, that, on saturating phosphoric acid, obtained by the slow combustion of phosphorus with soda, with a small excess of the soda, there is a salt formed, precisely of the same nature with Haupt's *sal perlatum*, or Rouelle's *fusible salt with a base of natrum*; and that, in order to obtain the substance described by M. Proust, nothing more is necessary but to deprive this neutral salt of its excess of soda, by vinegar, or to add to it a little phosphoric acid. After this, we need not be surprised to find Bergman representing the affinities of the *acidum perlatum*, as precisely the same with those of the phosphoric acid. This detail of particulars has been given by M. de Morveau, in a supplement to the acids of the mineral kingdom; and he grants, that after this, the *ouretic* acid, and *ouretic* salts, are no more to be mentioned. In addition to all these details, we have only to add further, in order to render the history of this salt complete, that phosphate of soda always contains a little phosphate of ammoniac, and that this last salt acts a part in all the combinations into which it enters.

It is very extraordinary, that phosphate of soda is not decomposable by carbone, like ammoniacal phosphate; —that carbone cannot deprive the phosphoric acid, when

in union with soda, of its oxigene. This base, therefore, renders this acid incapable of being decomposed by coal; although it does not act in the same way on the sulphuric, and various other acids. This is a striking exception from the general law of the attractive elections of oxigene, of which no other instance is yet known. It is not less remarkable, that an excess of phosphoric acid, added to phosphate of soda, gives to this compound, which, according to Mr Klaproth, is the peculiar substance of M. Proust, the power of rendering syrup of violets green.

M. de Morveau adds to the history of phosphate of soda, that a solution of muriate of lead poured into a solution of this salt, produces a precipitate of phosphate of lead. This last salt, by distillation with carbone, affords phosphorus; as M. de Laumont, inspector of the mines, has discovered with an ore from the mines of Huelgoet. From this it appears, in what manner corneous lead, the use of which, in the distillation of phosphorus of urine, has been proposed by Margraf, may augment the quantity of the product, as we shall explain in the following chapter.

Of the Lithic Acid.

THE calculus or stone that is formed in the human bladder, has long engaged the attention of chemists and physicians. Paracelsus, who gave it the barbarous name of *dulecb*, imagined it to consist of an animal resin, and compared it to arthritic concretions. Van Helmont thought it a concretion formed of the salts of urine, and an earthy volatile spirit; and believed it to be
of

of a very different nature from arthritic chalk, the formation of which was, in his opinion, owing to the thickening and acidification of the synovia. Boyle extracted from it, oil, with a good deal of volatile salt. Boerhaave admitted in it the existence of an earth in union with volatile alkali. Hales extracted from it 645 times its own bulk of air; and out of 230 grains, obtained no more than 49 grains of residue: He called it *animal tartar*. Many learned physicians, and especially Whyte and Deften, have considered alkaline matters as the true solvent of the urinary calculus. Several even proposed the use of the soap-makers' lixivium for that purpose. But none of these notions was founded on an exact analysis of the calculus. Scheele and Bergman first undertook such an analysis.

The former of these chemists discovered, that the stone in the bladder consists mostly of a peculiar acid, to which we give the name of the *lithic acid*. 70 grains of the calculus in the bladder afforded him, by distillation, 28 grains of this acid, in a dry and sublimated state,—some ammoniacal carbonate, and 12 grains of coal, which he found it very difficult to reduce to ashes. 1000 grains of boiling water dissolved 396 grains of the same acid: This lixivium reddened blue colours; but the greatest part separated in small crystals by cooling.

Concentrated sulphuric acid dissolves the calculus, with the help of heat; and passes, in consequence of effecting this solution, into the state of concentrated sulphureous acid. The muriatic acid does not act upon it; the nitric dissolves it entirely: nitrous gas and carbonic acid are disengaged, while this last solution is

taking place. This solution is red ; it contains a naked acid ; it communicates a red tincture to the skin, and all organic tissues : When tried with soluble barytic salts, it exhibits no mark of its containing sulphuric acid,—nor of lime, when tried with oxalic acid. Lime-water forms in it a precipitate, which dissolves, without effervescing, in acids. Caustic alkalis, according to Scheele, dissolve the calculus : these solutions are precipitated by lime ; 1000 grains of lime-water dissolve 537 of any of these precipitates ; and ammoniac, in a large proportion, acts in the same manner on the calculus. That celebrated chemist asserts, that the brick-coloured sediment in the urine of people in a fever, is of the same nature. Although Scheele found no lime in the stone of the bladder, yet Bergman obtained some from it, by precipitating the nitric solution with sulphuric acid, and calcining the residue of the same solution. Bergman likewise discovered in the calculus, a white spongy matter, insoluble in water, acids, or alkalis : The incinerated coal of this substance, of which the quantity was so small that he could not ascertain its nature, is not even soluble in nitric acid.

From this analysis by two such celebrated philosophers, which has been again and again repeated by different chemists, the stone in the bladder appears to be of a different nature from the earth of bones. Yet Mr Tennant, Fellow of the Royal Society of London, has found in the bladder, stones which lost only two thirds by calcination, and whose residue melted into an opaque glass by cooling. These must therefore have contained a pretty considerable quantity of calcareous

As to the lithic acid,—the properties which it is known to possess, are, 1. That of being concrete and crystalline: 2. That of being almost insoluble in water, but more soluble in hot than in cold water: 3. That of being soluble in nitric acid, from which it absorbs oxygen, and forming, after this solution, a deliquescent red mass, which communicates a colour to many bodies: 4. That of combining with earths, and metallic oxides; and forming with them peculiar neutral salts, which we call *ammoniacal lithiate*, *lithiate of copper*, *calcareous lithiate*, *lithiate of potash*, *lithiate of soda*, &c. 5. The property of preferring, in its attractions, alkalis to earths: 6. Lastly, that of yielding these bases to the weaker of the other acids, even to the carbonic acid, which renders the calculus insoluble by alkaline carbonates; this last property is peculiar to this acid. But, as M. de Morveau has very well observed, much remains to be done before we can obtain a sufficient knowledge of the lithic acid; and, I may add, even before we can determine whether it be not a modification of some other acid; which may be suspected from what we know concerning the relations of the vegetable acids to one another, and the identity of the pretended *acidum perlatum* and *ourctic acid*, with the phosphoric acid.

M. de Morveau thinks the concretions at the joints, which physicians have considered as of the same nature with the calculus of the bladder, to be, in their nature, very different from it. But his opinion is founded only on some experiments of Schenckius, Pinelli, and Whyte, which were far from being performed with due accuracy and attention: And the observations of Boerhaave, Frederic Hoffman, Springfield, Alston,

Leger, &c. concerning the good effects of alkaline waters, soap, and lime-water, in arthritic and calculous cases, have, with me, greater weight in establishing the analogy between these two sorts of concretions, than the others in destroying it. There is, however, no refusing to agree with M. de Morveau, that experiments only can determine the question. This is a new proof of the beneficial influence of chemical researches on the science of medicine, and the advantages which it may derive from them *.

C H A P.

* It is related by M. Röring, in the Memoirs of the Academy of Stockholm, for the year 1783; that the concretions expectorated by an old man subject to the gout, were found to be of the nature of bone or phosphate of lime.

In the first volume of the Medical Communications of London, Anno 1784, Dr Watson relates, that arthritic concretions were found to be soluble in the synovia, and to mix easily with oil and water; properties not belonging to the calculus—H.

C H A P. X.

Of Kunckel's Phosphorus.

PHOSPHORUS is one of the most combustible substances known. As it was first extracted from urine, and as the matter which affords the most of it, is ammoniacal phosphate, it seems therefore most suitable to give the history of this inflammable substance in this place.

The discovery of phosphorus is owing, according to Leibnitz, to an alchemist of the name of Brandt, a citizen of Hamburgh, who found it out in the year 1667. Kunckel, to gain the knowledge of the process, associated with a man of the name of Krafft : But Krafft not communicating to him the secret, Kunckel resolved to search for it himself; and after many experiments on urine, from which he knew it to be obtained, he at last produced phosphorus, and was considered as being truly the discoverer of it. Some also ascribe the honour of this discovery to Boyle, who, in the year 1680, actually gave a small quantity of it into the hands of the Secretary to the Royal Society of London. But Stahl asserts, that Krafft had told him, that he communicated his process for making phosphorus to Boyle. Boyle communicated his process to a German, whose name was Godfreid Hankwitz, who had an excellent laboratory at London, and was the only man that prepared

phosphorus, and sold it, through all Europe. Although, between the year 1680, and the beginning of the present century, there were produced many receipts for making phosphorus, and, among others, Boyle's, Krafst's, Brandt's, Homberg's, Teichmeyer's, Frederic Hoffman's Niewentyt's, and Wedelius's; yet no chemist had hitherto prepared it openly; and the preparation was still quite a secret, when, in the year 1737, a foreigner offered to communicate, at Paris, an infallible process for making phosphorus. The Academy named four chemists, Messrs Hellot, Dufay, Geoffroy, and Du Hamel, to try the process in the laboratory in the King's garden. The process succeeded. The minister bestowed a reward on the discoverer; and Hellot gave an accurate account of the process, in a Memoir, inserted among the Memoirs of the Academy for the year 1737. This process consists in evaporating five or six hogshheads of urine, till it be reduced to a granulated, hard, black, glistering matter,—calcining the residue in an iron pot, red-hot in the bottom, till such time as it cease to smoke, and take the smell of peach-flowers,—lixivating this matter with, at least, twice as much hot water,—and drying it, after decanting off the water. Three pounds of this matter must be mixed with a pound and an half of coarse sand, or pounded stoneware, and four or five ounces of powder of charcoal of beech. This mixture is to be moistened with half a pound of water, and introduced into an Hessian retort. The matter is assayed, by making a portion of it red-hot in a crucible: If it exhibit a violet flame, and diffuse a smell of garlic, it will afford phosphorus. The

retort is placed in a furnace made on purpose ; and a large balloon, about one third of which must be filled with water, adapted to it. The balloon must be perforated with a small hole ; and Hellot considered this as one of the manipulations that are the most necessary for the success of the operation. Three or four days after the apparatus has been set up, a moderate fire is kindled under it, to dry the furnace and the lutings : by degrees, the fire is augmented, and it is kept for fifteen or twenty hours in this state. The phosphorus does not distil till fourteen hours after the beginning of the operation, which lasts, in all, twenty-four hours. There arises, first, a large quantity of ammoniacal carbonate, a part of which is dissolved by the water in the balloon. Volatile or æriform phosphorus passes, next, in luminous vapours : the true phosphorus then runs, like an oil, or melted wax. When it ceases to pass, the apparatus must be left to cool for two days. The luting must then be taken off ; and water added, to loosen the phosphorus adhering to the sides of the receiver : It is now melted in boiling water ; for which purpose, it is cut into small pieces, which are introduced into the necks of matrasses, cut towards the middle of the body into the form of a funnel, and immersed in boiling water. The phosphorus melts, is purified, and rendered transparent by the separation of a blackish matter which rises above it. It is then put into cold water, where it congeals ; and it is now thrust out of the matrasses with a small stick.—Such, in short, is the process described by Hellot. The tediousness of the operation hindered it from being repeated by any chemists but

Rouelle,

Rouelle, the elder, who, in his courses of chemistry, went through it several times with success.

In the year 1743, Margraf published, in the Memoirs of the Academy of Berlin, a new method for making, at once, a pretty large quantity of phosphorus, easier than had been done before him. In this process, the corneous lead which remains from the distillation of four pounds of *minium*, and two pounds of ammoniacal muriate, is mixed with ten pounds of extract of urine, of the consistency of honey. A pound and a half of powder of charcoal is next to be added to it. The mixture must be dried in an iron pot, till it be converted into a black powder. This powder is to be distilled in a retort, in order to extract from it, by a graduated fire, the ammoniacal carbonate, the foetid oil, and the ammoniacal muriate which it contains. Care must be taken, however, to urge it with fire no farther than just to make the retort red-hot. The black friable residue of this distillation, is the matter from which the phosphorus is extracted. It is assayed, by casting a little of it on burning coals. If it diffuse a smell of garlic, and a blue phosphoric flame, it may then be considered as well prepared. A retort of Hessian or Picardy earth is filled three-fourths full of it, and well luted. This vessel is then placed in a reverberating furnace, with a dome, and an iron chimney, six or eight feet high. A middle-sized receiver, perforated with a small hole, and half-full of water, is fitted to the retort. The joinings must be luted with fat-lute, and covered with fillets of cloth dipped in white of eggs, and lime : A brick-wall must be raised between the furnace and the receiver ; and after this apparatus has been suffered to dry for a day or two, the distillation may be carried

ried on by a properly graduated fire. This operation lasts from six to nine hours, according to the quantity of the matter to be distilled. The phosphorus, thus obtained, is rectified by distilling it by a very moderate fire, in a glass retort, with a receiver half-full of water. Almost all chemists have repeated Margraf's process successfully: and it was the only one in use, till, within these few years, another was discovered, which consists in separating the phosphoric acid from bones; as we shall mention when we come to speak of solid bodies.

It appears that the only thing in which Margraf's process differs from Hellot's, is in the addition of the muriate of lead, and the division of the operation into two. But what is of most importance in the ingenious chemist of Berlin's process, is, that it determines the nature of the substance contained in urine, which serves for the formation of phosphorus. By distilling a mixture of *fusible salt* with charcoal, he obtained excellent phosphorus; and he observes that the urine from which he had extracted that salt would yield no more of this combustible substance. That substance, therefore, which contributes to the formation of phosphorus, must be a constituent part of fusible salt; and indeed phosphorus is easily obtained by distilling two parts of glass obtained from the decomposition of fusible salt in a retort or crucible, with one part of powdered charcoal. This operation requires much less time, and much less fire, than any we have yet described; for, according to M. Proust, the phosphorus is ready to run in quarter of an hour. This, doubtless, is the best process that can be used to obtain phosphorus of urine. But there are several observations to be made on this head: 1. The vitreous

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vitreous residue, remaining after the decomposition of ammoniacal muriate by fire, not being pure phosphoric acid, but phosphoric acid in combination with phosphate of soda, which is not decomposable by coal, only a very little phosphorus can, therefore, be obtained by employing this residue,—an ounce of it affording no more than a drachm, and often less: 2. When fusible salt is prepared in any large quantity by evaporation and cooling, it is found to be mixed with a considerable proportion of phosphate of soda, which affords no phosphorus. These two observations may be, therefore, considered as explaining, why so little of this combustible body is obtained by the distillation of fusible salt with coal. Perhaps, fusible salt in its original state, or the mixture of ammoniacal phosphate with phosphate of soda, if distilled with coal and muriate of lead, would afford more phosphorus; for muriate of lead appears to be capable of decomposing phosphate of soda.

Phosphorus, by whatever of these processes obtained, is still the same. When very pure, it is transparent, and its consistency like that of wax. Its crystallises by cooling, into brilliant plates of a micaceous appearance. In hot water, it melts a considerable time before the fluid be heated to ebullition. It is highly volatile, and rises in a thick fluid by a moderate heat. In contact with air, it exhales a thick smoke from every part of its surface: this vapour diffuses a strong smell of garlic, and appears white in day-light, and in the dark very luminous. It is a slow inflammation of the phosphorus from which it proceeds; and when left for any time exposed to the air, phosphorus is gradually consumed, and leaves as a residue a peculiar acid, the properties of which we

will afterwards examine. This slow combustion never takes place but when the phosphorus is in contact with air: Nay, to render it very luminous, a heat from twelve to fifteen degrees of Reaumur's thermometer, or about sixty-three degrees of Fahrenheit's, is requisite; although the inflammation may take place under that temperature. This inflammation is not accompanied with heat, nor does it kindle any other combustible body. But when phosphorus is exposed to a dry heat of 24 degrees Reaumur, or 86° Fahrenheit, it kindles with decrepitation: it burns rapidly with a very lively white flame, mixed with yellow and green, and destroys very speedily any combustible body that comes within its influence. The vapours which then exhale from it are very copious, white, and very luminous in the dark. This rapid combustion takes place with a very strong heat, and a very sparkling light, in a receiver full of vital air.

In these two different sorts of combustion, phosphorus leaves different residues. The first affords a liquor weighing more than twice as much as the phosphorus employed on the occasion, which we call the *phosphorous acid*. The second gives a very deliquescent and soluble white, concrete matter, which is the *phosphoric acid*. This last was thought to resemble the acid and fluid residue of the first combustion, or the slow inflammation. But the two acids exhibit real differences in their combinations, as was first observed by Margraf, and has been shewn by M. Sage, in the Memoirs of the Academy for the year 1777. We will speak more particularly of these differences in the history of the two acids.

The combustion of phosphorus was considered by
Stal

Stahl as the disengagement of the phlogiston which he thought to be combined with muriatic acid * in that combustible body. M. Lavoisier, in order to distinguish what happens in this combustion, kindled, with a red-hot iron, a quantity of phosphorus in a bell-glass immersed in mercury. He observed, that no more than a given quantity of this matter can be burnt in a certain bulk of air; that the quantity amounts to one grain of phosphorus to sixteen or eighteen cubic inches of air; that, after this combustion, the phosphorus is extinguished, and the air rendered unfit to contribute to the combustion of a new quantity of phosphorus; that the bulk of the air is diminished, and the phosphorus converted into white, snowy flakes, which fix on the sides of the bell-glass: These flakes are equal to twice and one half more, the weight of the phosphorus from which they are formed; and this increase of the weight of the phosphorus corresponds exactly to the diminution of weight which the air has suffered, and is owing solely to the absorption of phosphorus by the oxigene. In fact, the white flakes are concrete phosphoric acid, produced by the combination of phosphorus with the oxigene, or base of vital air, contained in the atmospheric air which has contributed to the combustion of that inflammable substance. The theory of this substance is the same with that

* Stahl, in several of his works, has asserted, that phosphorus may be composed by combining muriatic acid with phlogiston. Margraf engaged in a series of experiments with a view to this, in which he treated various combinations of the muriatic acid with combustible matters; but could never succeed. He has even shewn, in a satisfactory manner, that the acid formed by the burning of this combustible body, is very different from that of marine salt; and all chemists are now of the same opinion. — F.

that of sulphur; and it is therefore unnecessary to make any addition here to what was said on that head, in the mineral kingdom. We shall only observe, that of all combustible bodies, phosphorus seems to disengage the greatest quantity of caloric and light from vital air, and that it absorbs the oxygen in the most solid state.

Phosphorus becomes liquid in hot water. Vital air, passed through phosphorus thus liquefied in water, burns it, and reduces it into the state of phosphoric acid.

Phosphorus, though not soluble in this fluid, yet suffers, by degrees, an alteration in it. It loses its transparency, becomes yellow, and is covered over with an efflorescence, or coloured dust. The water becomes acid, and appears luminous when shaken in the dark. The phosphorus is then slowly decomposed.

Caustic fixed alkalis dissolve phosphorus, with the help of a boiling heat. While this combination takes place, there is a foetid gas disengaged that was first discovered by M. Gingembre, and possesses the singular property of kindling with an explosion, when brought into contact with atmospheric air, and more instantaneously still, when brought into contact with vital air. This elastic fluid consists of phosphorus dissolved in hydrogenous gas; and the hydrogenous gas is produced by the decomposition of the water. We call it *phosphorated hydrogenous gas*.

Sulphuric acid, distilled in a retort, with phosphorus, burns it almost entirely, but without emitting any flame. Concentrated nitric acid acts upon it with violence, and, if the phosphorus be hot, kindles it suddenly. When this experiment is made in a retort, with

nitric acid not very highly concentrated, the phosphorus burns slowly, robs the nitric acid of its oxygen, and forms phosphoric acid. This process was described by M. Lavoisier in the year 1782.

The muriatic acid does not act in a sensible degree on phosphorus; but the oxygenated muriatic acid burns it with great ease.

If phosphorus be dipped in the oxygenated muriatic acid gas, it kindles instantly, and burns with noise.

Nitric salts, with the help of a gentle heat, kindle it with great rapidity.

Sulphur and phosphorus combine, according to Margraf, by fusion and distillation. The result is a solid compound, of a foetid smell, which burns with a yellow flame, and, in water, swells, and communicates to it the acidity and smell of alkaline sulphures; which properties shew, that these two bodies re-act on each other in a peculiar manner, as their union seems to occasion the decomposition of water. M. Pelletier has observed, that sulphure of phosphorus, or phosphorus of sulphur, denominations that mark the reciprocal proportions of these two bodies, is infinitely more fusible than either the one or other of these bodies apart.

Phosphorus does not combine so well as sulphur, with metals, though there be, in many particulars, a strong analogy between phosphorus and sulphur. Margraf attempted to form these combinations by distilling each of the metallic substances with two parts of phosphorus. None but arsenic, zinc, and copper, exhibited peculiar phenomena. None of the other metals was at all altered by the phosphorus, which was partly burnt or sublimated

imposed in the receiver, without suffering any discernible change.

Phosphorus sublimated with arsenic, afforded that celebrated chemist, a matter of a beautiful red colour, not unlike realgar.

Zinc, distilled twice in succession with this combustible substance, afforded yellow flowers, punctuated and very light. The sublimate, when exposed to the action of fire, under a red muffle, kindled, and melted into a transparent glass, like that of borax.

Copper, treated in the same way with phosphorus, lost its brilliancy, and became very compact. Its weight was increased sixteen grains in the half drachm, and it burnt when exposed to flame. M. Pelletier has observed, that copper combines very well with phosphorus, and that the result of this combination is a sort of grey ore, brilliant, granulated, very hard, and very difficult to melt. To these compounds into which phosphorus enters unaltered, we give the name of *phosphures* of copper, zinc, arsenic, iron, &c. M. Pelletier in his enquiries concerning metallic phosphures, followed a very different method from Margraf. To effect these combinations, he mixed the metals with the vitreous phosphoric acid and a little coal. In proportion as phosphorus is produced by the action of the coal, it combines with the metal. In this way, he has been able to melt platina with great ease, and to form a phosphure of platina, that will help to purify this useful metal.

The Marquis de Bullion and M. Sage have described a remarkable alteration which phosphorus suffers in metallic solutions. The first of these chemists discovered,

that small pieces of phosphorus, introduced into solutions of gold, silver, copper, &c. were gradually covered with a crust, or a sort of bright metal case. These elegant experiments shew, that phosphorus has a greater affinity with oxigene than several of the metals, and is capable of reducing their oxides. Bergman has established it as an unquestionable fact, that the arsenic acid is blackened and reduced into the state of arsenic when heated with phosphorus; which, at the same time, as it deprives the semi-metal of its oxigene, is converted into phosphoric acid.

Phosphorus is soluble in all oils; and renders them luminous. Spielman has discovered, that it dissolves in alcohol, and that the solution emits sparks, when poured into water. In this operation, a part of the phosphorus is precipitated in a white powder.

Phosphorus has not yet been much used, either in medicine or in the arts. Messrs. Menzius, Morgenstern, Hartman, &c. say, that they have found it produce good effects in malignant and bilious fevers, when the strength has been exhausted, and in the miliary fever. Some authors have recommended it in the scarlet fever, the peripneumony, rheumatic pains, epilepsy, &c.; but though, in Germany, several dissertations have appeared on the medicinal virtues of phosphorus taken internally, yet nothing can be affirmed as certain on this head, till experience shall pronounce concerning it in a more decisive manner.

C H A P. XI.

Of the Phosphoric and the Phosphorous Acid.

THE phosphoric acid has been so called, because it was thought to exist ready-formed in phosphorus, from which it is obtained by combustion. But M. Lavoisier has proved this salt to be a combination of phosphorus with oxigene.—There are four different processes for obtaining this acid. The first consists in burning phosphorus hastily, under bell-glasses, full of atmospheric air, and immersed in mercury, by the heat of a burning-glass, or by touching it with a red-hot iron. Care must be taken, to put a little water on the sides of the glasses before the process commence. This process, invented by M. Lavoisier, affords, in a short time, a quantity of phosphoric acid, mixed with a small quantity of unburnt phosphorus,—that is, of acid in part phosphorous. Vital air may be used in the act of combustion. In truth, the inflammation is so rapid and so violent, as often to break in pieces the glasses with a noise. The process affords phosphoric acid.

The second process, which we owe to Messrs Woulfe and Pelletier, is performed by passing a stream of vital air through phosphorus melted under water.

In the third, given by M. Lavoisier, the phosphorus is burnt by means of nitric acid, not very strong.—

Both these processes produce phosphoric acid.

The fourth process, a slow combustion, which has been improperly called the formation of phosphoric acid by *deliquium*, is very well described by M. Sage.—Sticks of phosphorus are placed on the sides of a glass funnel, the stalk of which enters a bottle; and its base is covered with a capital, the extremity of which remains open. A tube of glass is put into the neck of the funnel, to prevent the phosphorus from escaping, and to afford, at the same time, a passage, through which the air, displaced by the acid, may move off. Care must be taken to keep the sticks of phosphorus from touching each other, and to prevent the temperature of the place in which the apparatus stands from rising above sixty degrees; otherwise the phosphorus may probably deflagrate. In more or less time, there is obtained by this process, for every ounce of phosphorus, three ounces of acid, which is collected and flows, by degrees, into the water in the bottle: it is phosphorous acid.

These four processes afford acid of phosphorus, in two different states, according as the phosphorus is either not decomposed, or entirely burnt and saturated with oxygen. These two acids between them, exhibit phenomena, which may be compared to those of the sulphuric and the sulphureous acids.—Such is the origin of the differences between the results obtained by Messrs. Sage and Lavoisier, in the combinations of this acid, which are related in the Memoirs of the Academy for the year 1777, as already mentioned. We distinguish the former, that in which the phosphorus is saturated with oxygen, by the name of the *phosphoric acid*; and the second, which is not entirely saturated with oxygen, we call the *phosphorous acid*.

Of



Phosphoric Acid:

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Of the Phosphoric Acid.

PURE phosphoric acid, obtained without the addition of water, and in vital air, is in the form of white flakes, snowy, light, deliquescent, and of a very strong acid taste. When exposed to the air, it speedily attracts moisture. When brought into contact with a little water, it easily melts, and affords a white fluid, without smell, of an oily consistency, very ponderous, of a taste strongly acid, and capable of changing blue vegetable colours rapidly into red. If exposed to the action of fire in a retort, it affords a pure phlegm: the acid then concentrates, and becomes even more ponderous than the sulphuric acid: it assumes, by degrees, consistency and opacity; it is then like a soft extract. Lastly, when urged with a violent heat, it melts into a transparent glass, which is hard, highly electric, and insoluble, but exhibits none of the properties of an acid. It appears, that this solid vitreous state of the phosphoric acid, is owing to a more intimate combination taking place between the acidifiable base and the oxigene, and to the separation of a part of the latter. This idea, of a more intimate adherence taking place between the oxigene and the acidifiable base in phosphoric glass, which, as it is no longer acid, merits the name of *vitreous phosphoric oxide*, is confirmed, when we observe how difficult it is to obtain from it phosphorus, with the help of coal, and how strong a heat must act on this mixture, to produce the desired effect.

Phosphoric acid obtained by slow combustion, or phosphorous acid, when heated in an open vessel, emits, from time to time, a faint flame, which is owing to its still

retaining a residue of phosphorus that has not been all burnt, and the flame is accompanied with a smell of garlic. It then is concentrated, becomes dry, and at last melts like the former acid.

The concentrated phosphoric acid very speedily attracts moisture from the atmosphere. It combines with water, with the help of heat : it combines with a great many substances ; and, in its combinations, exhibits some peculiar phenomena.

The liquid phosphoric acid does not appear to have any power over siliceous earth, according to the experiments of Bergman and M. de Morveau : But it has been shewn by Dr Priestley and Mr Ingenhoufze, to act on glass.

The blow-pipe makes it bubble with aluminous earth. Phosphoric acid, when melted in Hessian crucibles, has been remarked, by M. de Morveau, to communicate to them a transparent vitreous covering.

It combines with barytes, and seems to prefer it to all other bases but lime, if the affinities of this acid have been rightly marked by Bergman. The properties of barytic phosphate are still unknown.

The phosphoric acid dissolves carbonate of magnesia, with effervescence. The salt which it forms with this substance is scarce soluble. A concentrated solution of it affords, by rest, in the space of four and twenty hours, small flat needle crystals, very slender, several lines in length, and cut obliquely at the two ends : it often takes the form of a transparent jelly. These crystals of phosphate of magnesia, when exposed to a gentle heat, fall into powder. According to M. Lavoisier, the sulphuric acid decomposes this salt.

Phosphoric acid, poured into lime-water, precipitates
from

from it a scarce soluble salt, which does not effervesce with acids,—is decomposed by mineral acids, but is proof against the attacks of caustic alkalis. This salt is of the same nature with the base of bones.—An excess of phosphoric acid renders calcareous phosphate soluble in water; but magnesia, lime, caustic fixed alkalis, and even ammoniac, by carrying off from it the excess of acid, precipitate the neutral salt. Calcareous phosphate is not decomposable by caustic alkalis; but carbonates of potash and soda decompose it. The solid matter of bones consists of phosphate supersaturated with lime.

Phosphoric acid, saturated with potash, forms a very soluble salt, which, by evaporation and cooling, affords, though not without difficulty, crystals, in the form of tetrahedral prisms, terminating in pyramids, which have also four faces, corresponding to those of the prisms. This phosphate of potash dissolves much better in hot than in cold water: it swells on coals, but is somewhat obstinate against melting; and when melted, has no longer a saline taste. From the nitric solution of silver, it produces a white precipitate; and from the nitric solution of mercury, a yellowish white precipitate. It is decomposed by lime-water, which has a greater affinity than potash, with the phosphoric acid.

Soda, in union with the phosphoric acid, affords a salt, of an agreeable taste, much the same with that of muriate of soda. Phosphate of soda does not easily crystallize, and is often reduced, by evaporation, into a gummy matter, which runs into threads like turpentine, and is deliquescent. I have observed, in this thick matter, needles disposed in radii, which indicate a beginning of crystallisation: But a little more soda than what is re-

quisite to saturate the acid, added to this salt, instantly effects a change of its properties: its taste now becomes urinous; it turns syrup of violets green, crystallises in large parallelograms, and effloresces in the air; in a word, it acquires all the properties of the fusible salt with a base of natrum, which we call *superfaturated phosphate of soda*. This salt does not afford phosphorus with coal; and neither phosphate of barytes, of lime, of potash, nor of soda, is liable to such a decomposition: Wherefore it appears, that the phosphoric acid must be in a naked disengaged state, in order to be decomposed by coal.

The ammoniacal phosphate produced by the combination of phosphoric acid with ammoniac, is more soluble in hot than in cold water, and affords, by cooling, crystals, which, according to M. Lavoisier, bear some resemblance to those of alum. I have remarked, that when the combination is truly neutral, it is very difficult to obtain it in crystals; for it is almost all evaporated even by a moderate heat. But an excess of ammoniac is favourable to the crystallisation of this salt: A little phosphate of soda produces the same effect; and this is the state of that extracted from urine. Barytes, lime, and alkalis, decompose ammoniacal phosphate: Fire easily disengages the ammoniac; and accordingly, this salt affords phosphorus with coal.

The phosphoric acid decomposes alkaline sulphates, nitrates, and muriates, by the dry way; and by its fixity, disengages the acids; but, in the humid way, it yields its bases to these acids.

The phosphoric acid, in a fluid state, acts only on a few metallic substances. It dissolves zink, and iron, and copper,

copper, readily enough. None of these solutions affords crystals by evaporation, except the solution of iron, which, indeed, seems susceptible of crystallization. The others form into soft ductile masses, like extracts: when urged with fire, they emit sparks, and appear to form genuine phosphorus. Margraf, and the Academicians of Dijon have examined the different phenomena exhibited by this acid, in its action on metals and semi-metals.

The phosphoric acid likewise precipitates some solutions of metals, such as the solutions of mercury and silver by the nitric acid.

The nitric and acetous solutions of lead are, in like manner, liable to be precipitated by phosphoric acid, and by soluble phosphates. The precipitate produced by the decomposition of the latter, which is phosphate of lead, affords phosphorus, when distilled with coal.

This acid re-acts upon oils, and improves their smell. To oils not naturally sweet-smelling, it communicates a sweet smell, in some degree æthereal: some of them it thickens.

When distilled, in its dry state, with coal, it affords phosphorus.

By heating it in a retort, with alcohol, the Academicians of Dijon obtained a liquor highly acid, of a pungent and disagreeable smell, which burnt with a little smoke, and exhibited some of the properties of æther. The phosphoric acid became volatile in this experiment, and seemed to acquire the properties of the phosphorous acid, for the product was acid. M. Lavoisier observed heat to be produced by this mixture. Most chemists, however, consider the phosphoric acid as insoluble in alcohol. Margraf, Rouelle, Scheele, Messrs Wenzel, Laffonne, Cornette,

Cornette, and the Duke de Chaulnes, recommend the use of alcohol to purify the phosphoric acid, and separate from it any extraneous matters which it may happen to contain.

Lastly, phosphoric acid, holding in solution phosphate of soda, affords, by fusion, an hard glass, insipid, insoluble, not deliquescent, and opaque, resembling that which fusible salt leaves, when urged with fire.

We may add farther, that the phosphoric acid, which was formerly thought peculiar to urine, exists in a great many animal matters, as we have already seen, and as will farther appear in the succeeding chapters. Margraf informed the world of his having found it in vegetables. M. Berthollet has extracted it from such as afford ammoniac by distillation: M. Hassenfratz, from a great many plants growing in marshes, and on peat-earth. It has been found in various minerals, particularly in lead and iron, with which it appears to be combined in consequence of the decomposition of animal substances. Lastly, M. Proust has found it in combination with lime, in a sparry stone, in Spain.

Of the Phosphorous Acid.

It has been related, that when phosphorus burns slowly, and is not completely saturated with oxygen, there is an acid formed, different from that whose history we have just finished, and bearing to it the same relation which the sulphureous bears to the sulphuric, the nitrous to the nitric, and the acetous to the acetic acid. This difference between these two acids, in the proportion of oxygen that enters into their composition, occa-

shows a wide difference between their properties, in the same manner as in the other fix which correspond, two and two. The phosphorus may be also considered as phosphoric acid, holding in solution a little phosphorus. This acid, when rubbed, and, still more, when heated, takes a foetid and disagreeable smell: part of it is then volatilized, in a very acrid and pungent white vapour: it is then more volatile than phosphoric acid. But this acid never rises all in vapour, like the sulphureous acid; it always contains more or less phosphoric acid, which causes it to leave a vitreous residue, or a melted phosphoric oxide, when treated with a strong fire. It may be prepared by decomposing phosphoric acid; and in the production of phosphorus, there is always a certain quantity of it disengaged. The distinctive properties of the phosphorous acid have not been all, as yet, particularly examined; but enough is known of them, to mark the difference that prevails between this and the phosphoric acid. M. Sage, in the Memoirs of the Academy for the year 1777, has given an account of some of the characteristic properties of the phosphorous acid. According to that chemist, the salt formed by the union of the acid obtained from phosphorus by *deliquium*, with potash, or phosphate of potash, is not deliquescent: Phosphate of soda is also crystallisable, but not deliquescent; but ammoniacal phosphate attracts moisture from the atmosphere*.

C H A P.

* It may be here added that *Crell*, having concentrated the phosphoric acid to dryness, found its specific gravity to be as 3.1 to that of water.—H.

C H A P. XII.

Of the Soft and White Parts of Animals, and of their Muscles.

ALTHOUGH less progress has been made in the analysis of the solid parts of animals, than in the analysis of animal fluids, yet we are beginning to know something of the different matters of which they are composed. In the first place, we know, that difference of texture both indicates and occasions a difference in constituent principles. This assertion will be confirmed, by a comparative examination of the soft and white parts, with the muscles and bones.

All the soft and white parts of animals, such as the membranes, the tendons and aponeuroses, the cartilages, the ligaments, and the skin, contain, in general, a mucilaginous substance, which dissolves readily in water, but is insoluble in alcohol, and is known by the name of *jelly*. To extract this jelly, nothing more is requisite than to boil these parts of animals in water, and to evaporate the decoction, till it forms, by cooling, into a solid tremulous mass. When evaporated by a more violent heat, it affords a dry, brittle, transparent substance, that is known by the name of *glue*.

Glue is prepared from all the white parts of animals. The skin, the gristles, and the feet of cows are used in the preparation of a strong glue, in England, Flanders, Holland, &c. The skin of the eel is the basis of gild—

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re's glue. A species of glue, used by painters, &c. is prepared of the parings of glove-leather and parchment. In short there is scarce any animal, whose tendons, gristles, nerves, and skin—which is still better for the purpose, may not be used in the preparation of these different sorts of glue.

It is to be observed on this head, that glues differ in consistency, colour, taste, smell, and solubility. Some glues dissolve well enough in cold water: and others are only soluble in boiling water. The best glue is transparent, of a yellow colour inclining to brown, without smell or taste, and entirely soluble in water, in which it forms a viscid fluid, of an uniform appearance, and which, when it dries, remains equally transparent and tenacious through all its parts.

Animal jelly differs from glue, properly so called, only in being less consistent and viscid. The former of these substances is obtained chiefly from the white and soft parts of young animals: it is also found in their flesh, muscles, skin, and bones. Glue is obtained only from the older animals, whose fibres are stronger and drier. However, as these two matters exhibit the same chemical properties; in the examination of them, on which we are entering, we shall take, for our specimen, the jelly that is obtained from the cartilages or membranes of the calf.

This matter has, in its natural state, scarce any smell: Its taste is insipid. When distilled on a water-bath, it affords an insipid, inodorous phlegm, liable to putrefaction. As it loses its water, it takes the consistency of glue, and, when thoroughly dried, is like horn. When exposed to a pretty strong heat, and to air at the same time,

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time, it swells, bubbles, and becomes liquid: it then becomes black, and exhales a copious smoke, of a foetid smell: it does not take fire, unless when exposed to a violent heat; and even then not readily. By distillation in a retort, it affords an alkaline phlegm, an empyreumatic oil, and a little ammoniacal carbonate. It leaves a coal of considerable bulk, which is not easily incinerated, and contains muriate of soda and calcareous phosphate.

Jelly, exposed to a hot and humid atmosphere, first becomes acid, and soon putrefies.

Water dissolves it in any proportion. Acids dissolve it easily, and alkalis still easier. The nitric acid disengages azotic gas from it. Most of these properties are nearly the same with those of insipid vegetable mucilages; only, insipid vegetable mucilages neither afford ammoniac by fire, nor azotic gas by the nitric acid. But this animal jelly may possibly owe these properties to a portion of albuminous matter, extracted by the water, at the same time with the gelatinous substance, especially when either glue or jelly is prepared by a long and strong decoction.

The muscles of animals consist of a parenchymatous cellular substance, which contains various humours, partly concrete, partly fluid. These humours are composed, 1. Of a red and white albuminous fluid: 2. Of a gelatinous mucilage: 3. Of a sweet oil, of the same nature with fat: 4. Of a peculiar extractive substance: 5. Lastly, Of a saline matter, the nature of which is not very well known. As the analysis of the flesh entire, which affords, in the water-bath, a vapid water, and in the retort, an alkaline phlegm, empyreumatic oil, and ammoniacal

ammoniacal carbonate, and leaves a coal that affords, by incineration, a little fixed alkali, and some muriate of soda or potash,—as this analysis affords no satisfactory information concerning the nature of these different principles, recourse must therefore be had to some means for extracting these substances unaltered, in order that we may be enabled to examine their properties separately.

To obtain and separate these several substances, the existence of which has been ascertained by M. Thouvenel, various modes of operation may be adopted. This physician squeezed out, in a press, the fluids contained in the muscular sponge; he coagulated the albuminous part by the action of fire, and obtained the salt by evaporation; he dissolved and separated the gelatinous mucilage, the salt, and the extract, with water; and by means of alcohol, he took off the two latter of these principles unmixed with jelly. It is generally very difficult to separate these different matters exactly; because they are all soluble in water, and alcohol dissolves, at the same time, both the saponaceous extract, and a part of the salt. The process which succeeds best, seems to be that which consists in, first, washing the flesh in cold water, which carries off the colouring matter, with a part of the salt; then digesting the residue which remains after this washing, in alcohol, which dissolves the attractive matter, and a part of the salt; and lastly, boiling the flesh in water, after treating it with these two processes. This fluid dissolves the gelatinous part by ebullition; and likewise carries off such portions of the extract and the salt, as have escaped the
action

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action of the former solvents. A slow evaporation of the first water that was employed, in the cold, coagulates the albuminous part, which may then be separated by filtration; and from this filtrated liquor, the saline matter may be obtained by another slow evaporation. By evaporating the alcohol in the same way, the coloured extractive matter is obtained: And lastly, decoction separates the jelly and the fat oil, which then swim on the surface, and are fixed by cooling. After the extraction of these several substances, nothing remains but the fibrous tissue: it is white, insipid, and insoluble in water: as it burns, it shrinks and contracts: it affords a good deal of ammoniac and very foetid oil in the retort, and a good deal of gas azote by the acid of nitre. Lastly, it possesses all the properties of the fibrous part of the blood. It appears, therefore, that the muscular organ is the reservoir in which the vital functions deposite the fibrous matter; which becomes concrete by rest, and appears to be the focus, or basis of that property of animals, which is denominated *irritability* by physiologists.

All that now remains to be done, in order that we may gain an accurate knowledge of the flesh of animals, is, to examine the properties of each of the substances of which it consists.

The albuminous matter, jelly, and fat substance, are already known to us. The first is precisely of the same nature with the albuminous matter of the blood; we may observe, that it is this substance, which, being coagulated by the heat of the water in which meat is boiled for soup, produces the froth which is so carefully skimmed off. This froth is of a dirty, brown-red colour;

for the original red colour of the albuminous matter is altered by the boiling heat. Jelly, obtained from flesh, generally causes soup prepared with the flesh of young animals, to form into a tremulous mass; for the flesh of young animals contains much more of it than the flesh of old animals: it is perfectly like that which composes the soft white parts of animals, the properties of which have been explained in the preceding article. The fat matter which forms the flat round drops that swim on the surface of soups or broths, and becomes solid by cooling, exhibits all the characteristic properties of grease. We have, therefore, nothing but the extractive matter, and the salt that is obtained in analysing the muscles, to examine.

The substance which M. Thouvenel calls *mucous extractive*, is soluble in water, and in alcohol: it has a discernible taste, whereas the jelly has none. When strongly concentrated, its taste becomes acrid and bitter: it has a peculiar aromatic smell, which is developed by fire. This is the substance which colours soups, and gives them the agreeable taste and smell by which they are distinguished. When they are too much evaporated, or when the proportion of the meat to the water is large, soups have then an high colour, and are more or less acrid in their taste. In short, the action of fire develops and improves the taste of this extractive matter, till it, at length, gives it the taste of sugar or caramel, as may be observed of the surface of the roasted meat, which is said to be *crisped*. When this extractive substance is evaporated to a dry consistency, and its properties still farther examined, its taste is observed to be acrid, bitter, and saltish: when put on a burning coal in this state, it swells, and becomes liquid; exhaling, at

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the same time, a pungent acid smell, like that of burnt sugar. If exposed to the air, it attracts moisture from it, and a saline efflorescence is formed on its surface : in an hot atmosphere, it becomes sour and putrid, if diluted in a certain quantity of water : and lastly, it is soluble in alcohol. These properties render this substance very nearly of the same nature with the saponaceous extracts, and the saccharine matter of vegetables.

As to the salt which is crystallised in the slow evaporation of a decoction of flesh ; its nature is not yet perfectly known. M. Thouvenel obtained it in down, or in imperfectly-shaped crystals. That chemist thinks this to be a perfect neutral salt, consisting of potash, and an acid which in frugivorous quadrupeds has the characteristics of the phosphoric, and in carnivorous reptiles those of the muriatic acid. Although this salt may be considered as unknown till such time as a sufficient quantity of it can be collected for a particular examination ; yet it is very probably either phosphate of soda, or ammoniacal phosphate ; and it may even be mixed with calcareous phosphate. These salts are proved to exist here, and even with the same excess of acid as in urine, by the white precipitates which lime and ammoniac form in soup, as well as by the nitric solution of mercury producing from it a rose-coloured precipitate.

We may add farther, that the substance the most plentiful in muscular flesh, and which peculiarly characterises it, is the fibrous part. This matter is deposited from the blood, in which it exists in a large proportion, and acts an important part in the functions of the animal œconomy. Physiologists have not been particular enough in their accounts of its nature and properties,

ties, and of the weight and quantity of the flesh of the muscles, in comparison with that of the other organs. The properties which distinguish this animal matter, are, 1. Insolubility in water: 2. That of affording more gas azote with the nitric acid than any other substance: 3. That of affording oxalic acid and malic acid, after the gas azote: 4. That of becoming easily putrid when moistened, and affording a good deal of ammoniacal carbonate by distillation.

These properties shew, that it consists of a fat or oily substance, in combination with azote, of phosphate of soda, and of calcareous phosphate, which are separated from it by the action of the nitric acid. I have considered the office of the fibrous matter in the animal œconomy, in a particular Memoir, inserted among the Memoirs of the Royal Society of Medicine *.

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C H A P.

* From the animal substances chemically described in this chapter, are soups, glues, and several other articles for the use of life, commonly prepared. For making portable soup, 4 lib. of calves feet, 12 lib. of beef, 3 lib. of veal, and 10 lib. of mutton, are boiled and passed through different processes, till they be reduced to the consistency of a paste; then divided into cakes, dried, and preserved in bottles; to be made into soup, when needed, by solution in warm water. The Chinese also prepare somewhat in this manner, from animal substances, those cakes of *bockiac* which are used in disorders of the lungs. Almost all glues are prepared from animal substances. They differ only in being, some weaker, some stronger. That glue which is called *isinglass*, is indeed prepared from the mucilaginous parts of a large fish found in the Russian seas: It is used chiefly by the silk and ribbon manufacturers. Glue is also made from eel-skins, from snails, and from the clippings of parchment. The glue or size, used by paper-manufacturers, is made from wheat-flour.—H.

C H A P. XIII.

Of the Bones of Animals.

THE bones are the support of all the other parts of animals,—the basis on which all the soft parts rest. These hard parts are not to be considered as passive in the animal œconomy : they are actually secretory organs, and separate from the blood and other juices, a peculiar saline matter, of which their own substance is formed, and which is designed to be accumulated in them as reservoirs.

The bones, considered as they exist in all animals, from man to the insect and the worm, differ in texture, in solidity, in position with respect to the muscles, and probably in the nature of their component principles. Chemical analysis has not yet ascertained any thing concerning this last particular. But one cannot help thinking, that the bones of men and quadrupeds must be of a different nature from those of fishes and reptiles, and still more different from the corneous skeleton of insects, and from the calcareous covering of shell-worms. The particular light in which we are here to examine the bones of animals, does not permit us to insist on these distinctions ; and chemists have not yet made any researches that can enable physiologists to determine concerning them.

The

The bones of men and quadrupeds, the only bones that have yet been examined by chemists, are not earthy matters, as was once thought. They contain a certain quantity of gelatinous matter dispersed through the small cavities which intervene between the solid plates of which their texture is composed; and those solid plates, too, which, from their insolubility and consistency, were taken for earthy matters, have been, within these few years, discovered to consist of a true neutral salt, the component principles of which are phosphoric acid and lime.

Bones, when exposed to fire, with concurrence of air, kindle, in consequence of their containing a certain quantity of medullary fat. When distilled in a retort, they afford an alkaline phlegm, a fetid empyreumatic oil, and a considerable proportion of ammoniacal carbonate. The coal which they leave is compact, and somewhat difficult to incinerate: It leaves a white residue, which, when washed in cold water, affords a small quantity of carbonate of soda. Hot water then separates from it a certain quantity of sulphate of lime. What remains after these lixiviations, is not soluble in water: it is the calcareous phosphate which Dr Gahn of Stockholm discovered, in the year 1769, to exist in bones. Bones calcined in the focus of a furnace, among coals, remain luminous in the dark: when urged with a very violent heat, they are half-vitrified, and are thus reduced to a sort of hard porcelain, very white, and semi-transparent. This property seems to be owing to the phosphoric acid: It might be made the subject of a particular art in pottery.

The water in which bones grated down are boiled, in

charged with a substance which renders it viscid, and is a true gelatinous matter.

Alkaline carbonates are capable of decomposing the calcareous phosphate which forms the basis of bones. This decomposition is mentioned by the chemists of the Academy of Dijon : they say, that they effected it on treating, by fusion, a mixture of powder of calcined bones, and carbonate of potash.

Acids act upon bones, and decompose the calcareous phosphate contained in them. It was by this means that Scheele, in the year 1771, prepared phosphorus from bones. He dissolved the bones in nitric acid. The acid seizing the lime contained in them, formed with it calcareous nitrate, which remained in solution, while the phosphoric acid was disengaged. Into this mixture he poured sulphuric acid, which, by detaching the lime from the calcareous nitrate, formed sulphate of lime : this sulphate of lime being precipitated as insoluble, he separated it by filtrating the liquor. Lastly, he distilled in a retort the filtrated liquor, which was a mixture of nitric acid and phosphoric acid ; and after evaporating it to the consistency of syrup, heated it with coal, in order to obtain from it phosphorus. Messrs Poulletier de Salle and Macquer were the first who repeated these ingenious experiments at Paris. After that, the academicians of Dijon, M. Rouelle, M. Proust, and M. Nicolas de Nancy, communicated their researches and processes on the same matters, to the public. Various other chemists have vied with these in examining the different solid matters of animal bodies. Among others, M. Berniard has obtained phosphoric acid from fossil bones, from whale-bones, from the bones of the elephant

phant and the porpoise, from those of the elk, from those of the cow, from human bones, from the teeth of the sea-cow, and from the grinders of the elephant; and he has observed, that all these bones afford the same substances, and contain phosphoric acid in various proportions. The Marquis de Bullion has obtained phosphoric glass from ivory, and from the bones of fishes.

The process mostly followed at present, in extracting phosphoric acid from bones, is that of the chemists of Dijon and St. Nicolas. The bones are burnt white, reduced to powder, and passed through a sieve: they are then mixed, in a vessel of stone-ware, with an equal quantity of concentrated sulphuric acid, and as much water is added as is sufficient to give the whole the consistency of clear soup: the mixture is now suffered to rest for some hours, in the course of which it becomes thick; it is then poured on a filtre of double cloth, and washed with water till the fluid pass through clear, and without acquiring any taste, or the property of precipitating lime-water. It is then certain, that the residue contains no naked phosphoric acid: the water which has been used in the washings is now evaporated; it deposits, by degrees, a white matter, which is sulphate of lime, and must be separated by the filter.

This salt must be carefully washed, in order to carry off all the phosphoric acid: these filtrations are to be repeated till the liquor cease to afford any sediment. The evaporation must be continued till it acquire the consistency of honey, or a soft extract. Its colour is then brown, and its appearance greasy. It is next put into a crucible, and heated till it cease to exhale a sulphureous and somewhat aromatic smell which at first

arises from it,—and till it cease to bubble. In this state, the consistency of this matter is half-vitreous, and its taste acid: it attracts moisture from the atmosphere. If urged farther with heat, it melts into a transparent glass, which is hard, insipid, and insoluble, and exhibits no mark of acidity. To obtain phosphorus from it, there is no occasion for waiting till this residue of the acid liquor, after evaporation, be brought into the state of an insoluble glass. In this state greater strength of fire is requisite; and even with that it yields phosphorus much slower than when soft and deliquescent. To reduce this glass into phosphorus, it must first be brayed to powder; then mixed with a quantity of dry charcoal, equal to one third of its own weight; next put into a stone-retort, with a balloon half full of water fitted to it, which balloon must be pierced with a small hole, or connected by a syphon with Woulfe's apparatus. Fire is to be gradually applied till the retort be first reddened, and then rendered white; the phosphorus then runs in drops; and the operation lasts, altogether, from seven or eight, to ten or twelve hours, according to the quantity of the matter that is distilled, and the degree of heat which the furnace is able to bear. Six pounds of bones usually afford twenty ounces, or somewhat more of a vitreous residue; and this residue affords about three ounces of very fine phosphorus, and a few drachms of phosphorus half decomposed. When the design is to prepare phosphorus of the phosphoric acid of bones, the acid must be evaporated to the consistency of an extract, and distilled with coal. Phosphorus is much more readily obtained by this process than by any other.

The

The case is the same with the acid product obtained from bones by the action of the sulphuric acid, as with the residue of ammoniacal phosphate decomposed by fire. That product is not pure phosphoric acid; for it never affords more than one fifth of its weight of phosphorus: it seems to contain a certain quantity of phosphate of soda. When this salt is mixed with calcareous phosphate produced from a little sulphate of lime, it usually melts with that phosphate, and forms with it a very hard opaque glass, which resists the action of all menstrua.

M. de Morveau has proposed a method for obtaining very pure ammoniacal phosphate from the phosphoric acid of bones. In order to that, dissolve the bones after calcination, in weak sulphuric acid; assay the solution with a solution of bones in the nitric acid, in order to ascertain whether there still remain in it any sulphuric acid in a naked state: then precipitate, by caustic ammoniac, the calcareous phosphate which it contains,—as has been done by M. Wiegleb, in his process: filtrate the liquor; and leave it to evaporate in the open air. You thus obtain very beautiful crystals of ammoniacal phosphate, mixed with a little phosphate of soda which separates by efflorescence: the calcareous phosphate remaining on the filter may be likewise decomposed, in order to form phosphorus from it.

C H A P. XIV.

*Of various Substances of Use in Medicine and the Arts,
which are obtained from Quadrupeds, the Cetaceous
Animals, Birds, and Fishes.*

WERE my design to give a minute and accurate history of all the animal substances used in medicine and the arts, I should have occasion to say more on this single head, than I have hitherto said concerning the whole animal kingdom ; especially when I should come to mention the different animal matters that were formerly introduced into medicine, by quackery or credulity, as famous specifics, and are now happily considered as entirely useless. I intend only to mention the principal of those substances,—such as chemical and medical experience has ascertained to possess powerful virtues, and such as are at present much used in the arts.

Of the matters which quadrupeds afford, we shall consider only castoreum, musk, and the hart's-horn. The white of the whale, and ambergrise, are the only products of cetaceous animals which will be here treated of. Of the products of birds, we shall give an analysis of the
eggs.

egg. Among oviparous quadrupeds and serpents, the tortoise, the frog, and the viper, will deserve to be separately considered. The only product of fishes which we shall examine, is the ichthyocolla. Insects will afford numerous subjects for examination : we shall consider cantharides, ants, wood-lice, honey and wax, filk, and the filk-worm, gum lac, kermes, cochineal, and crabs stones. Lastly, we shall close our examination of the products of the animal kingdom, with considering the nature of the coral and corallines, which belong to the class of worms or polypi.

From this brief enumeration of the matters which we mean here to consider, it will appear, that we mean to take no notice of a great many other animal matters which were formerly used in medicine ; such as, among others, ivory, the unicorn's horn, the teeth of the hippopotamus, of the beaver, and of the boar, the bones of the stag's heart, the feet of the elk, bezoar, civet, and the blood of the wild goat, among quadrupeds ; the swallow's nest, goose grease, peacock's dung, and the membrane of the stomach of poultry, among birds ; the toad and the scincus, among oviparous quadrupeds ; the gall and stones of the carp, the liver of the eel, the stones of the perch, and the jaws of the pike, among fishes ; the scarabæus, the spider's web, the meloe or proscarabæus, and the claws of the crab, among insects ; lastly, shell-worms, snails, oyster-shells, *nacres* of pearls, and bones of the cuttle fish, among the naked or covered worms. Of these substances, some possess none but imaginary virtues ; and the uses of others are better supplied by the substances which we have selected for examination.

§ I. *Of Castoreum.*

THE name of *Castoreum* is given to two bags situated in the inguinal region of the male or female beaver, containing a strongly odorous matter, which, when they are newly taken from the animal, is soft and almost fluid, but in the course of time becomes dry, and acquires the consistency of a resin. This matter has an acrid, bitter, and nauseous taste; its smell is strong, aromatic, and even fœtid: it consists of a coloured resin, soluble by alcohol and ether; a gelatinous, and partly extractive mucilage, which are taken up by water; and a salt, which crystallises when the aqueous solution is evaporated, but of which the nature is not yet known. The resin of castoreum, seems to be very nearly of the same nature with that of the bile. The whole of this animal product is included in membranous cells which proceed from the internal tunic of the bag in which they are contained. Castoreum has never yet been properly analysed: we know only that it affords a little volatile oil, and some ammoniacal carbonate, by distillation; and that, by means of æther, alcohol, and water, the several matters of which it consists may be separated.

It is used in medicine as an antispasmodic, in hysteric and hypochondriacal cases, and in the convulsions occasioned by those affections. It often produces the happiest effects very speedily; but at other times it irritates, instead of soothing; its effects being either favourable or unfavourable, according to the particular character of the nervous system of the patient. It ought therefore to be administered only in small doses, when it is first given.

It

It has been also prescribed with success for the epilepsy and tetanus. It is usually given in doses of from a few grains to half a drachm ; it is made into boluses ; it is generally, and almost always with good effects mixed with opium, and all calming or narcotic extracts. It is likewise used in a spiritous and an æthereal tincture, of which, from a few drops to four and twenty or six and thirty grains are given in certain drinks.

§ II. *Of Musk.*

MUSK, a substance of which the strong and permanent smell is generally known, is contained in a bag situated near the umbilical region of a ruminating quadruped so like the antelope, that it scarce deserves to be ranked under a different genus. This matter, in its chemical properties, resembles castoreum. It is a resin, combined with a certain quantity of mucilage, bitter extract, and salt. Factitious musk is often sold instead of the real. Its virtues are superior to those of castoreum : it is more active ; and is therefore never employed but in cases of extreme urgency. It is given as a potent antispasmodic, in convulsive disorders, in the hydrophobia, &c. It is likewise considered as a violent aphrodisiac. It should be very cautiously used ; for it often excites, instead of allaying nervous affections.

§ III. *Of Hartshorn.*

HARTSHORN is one of those animal substances which are the most used in medicine. It is a bony substance, and does not in any respect differ from bones. It contains

tains a considerable quantity of soft jelly, very light and nourishing, which is extracted by boiling it, after it has been first reduced into small pieces, in eight or ten times its own weight of water. By distillation in a retort, it affords a reddish ammoniacal phlegm called *volatile spirit of hartshorn*, an oil more or less empyreumatic, and a great quantity of ammoniacal carbonate contaminated with a little oil. There is disengaged from it a very large proportion of elastic fluid, consisting of a mixture of carbonic acid gas, gas azote, and hydrogenous gas with carbonaceous matter and even volatile oil dissolved in it. The oil, however, is gradually precipitated by cooling; it then adheres to the sides of the glass vessels containing the elastic fluid. As the volatile salt is coloured, it must be digested in a little alcohol, to free it of the oil by which it is contaminated. The carbonaceous residue, when incinerated, is found to contain a little carbonate of soda, some sulphate of lime, and a considerable quantity of calcareous phosphate mixed with phosphate of soda—which, as has been mentioned in the article of bones, is to be decomposed with sulphuric acid.

The spirit and salt of hartshorn are used in medicine, as good antispasmodics. The former, saturated with succinic acid, forms the succinated liquor of hartshorn.

Oil of hartshorn, when rectified by a gentle heat, becomes very white, strongly odorous, highly volatile, and almost as inflammable as æther. It is known by the name of *animal oil of Dippel*, a German chemist, who was the first that prepared it. It used formerly to be rectified a great many times, in order to render it very white and fluid. But it has since been observed

that two or three distillations are sufficient, provided care be taken, 1. To introduce the oil that is to be rectified, into the retort, through a long funnel, in order that the neck of the vessel may be very clean; for, a single drop of coloured oil would be enough to colour the whole quantity under distillation: and, 2. To take only the first portions, which are the whitest, and the most volatile. For these observations, we are indebted to Messrs Model and Baumé.—Rouelle has likewise given a very good process for obtaining this oil; it consists in distilling it with water. As none but the most volatile part, which is truly æthereal, and entirely contained even in the oil of the first distillation, can be volatilized by the heat of boiling water, we are sure of obtaining, by this mode of operation, nothing but the most subtle and penetrating part. This oil has a lively smell, and is amazingly light and volatile: it exhibits all the properties of vegetable volatile oils; and seems to differ from them only in containing some ammoniac; for, it turns syrup of violets green, as has been observed by M. Parmentier. This oil is used, in drops, in cases in which the nerves are affected, in the epilepsy, &c.*.

§ IV. *Of the White of the Whale.*

THE white of the whale, improperly called *spermaceti*, is an oily matter, concrete, crystalline, semi-transparent, and of a peculiar smell, which is taken from
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* M. Chaptal, in rectifying the empyreumatic oil of hartshorn, has been accustomed to distill it with earth of murriel, which retaining all the colouring part, gives the oil at once white and attenuated.—H.

the cranium of the cachalot, from two particular cavities distinct from the brain, and is purified by liquefaction, and by the separation of another oil, fluid, and not susceptible of concretion, which is mixed with it. This substance displays very singular chemical properties, in which it nearly resembles both fixed and volatile oils.

The white of the whale, when heated in contact with air, kindles, and burns in an uniform manner, without diffusing any disagreeable smell. Excellent candles are therefore made of it, in those places where it is prepared, at Bayonne, at St Jean-de-Luz, &c. In England, there are many manufactories of these candles: within these few years, some such have been established at Paris.

When distilled by naked fire, it does not, according to M. Thouvenel, yield any acid phlegm, like fixed oils, but passes entire, and almost unaltered, into the receiver, as soon as it begins to boil; leaving on the retort a carbonaceous mark. On repeating the operation, it loses its solid form, and remains fluid, without becoming more volatile.

The white of the whale, when exposed to hot air, becomes yellow and rancid, but not so easily as other fixed concrete oils. Water in which it has been boiled, affords, by evaporation, nothing but a light mucous unctuous residue.

Caustic alkali dissolves the white of the whale, and forms with it a soap which, by degrees, becomes solid, and at length friable.

The nitric and the muriatic acids are incapable of acting on this substance. The concentrated sulphuric

acid dissolves it, and, at the same time, alters its colour: this solution is precipitated by water, like oil of camphor.

The white of the whale combines with sulphur, like fixed oils.

Fixed and volatile oils dissolve the white of the whale, with the help of heat. Hot alcohol likewise dissolves it, but suffers it to precipitate by cooling. Ether effects this solution cold, or, at least, without the help of a greater heat than the natural warmth of the hand.

Perhaps, the white of the whale may bear the same relation to fixed oils which camphor bears to volatile oils. It differs essentially from wax, which seems to bear the same relation to the former, as resin to the latter.

Formerly, this substance was very much used in medicine; a great variety of medicinal properties were ascribed to it. It was used, especially, in cases of catarrh, erosions, ulcers of the lungs and reins, &c. At present, it is employed as a demulcent medicine; and, even for this purpose, in very small doses, and mixed with mucilages; for it is allowed to be heavy upon the stomach, and to occasion disgust, nausea, and even vomiting.

I have found, in animal matters, especially in the parenchyma of the liver, after drying it in the air for sometime, in the muscles of animals altered by putrefaction, and in human biliary concretions, a matter possessing nearly the same properties with the white of the whale. This substance, therefore, appears to me to be very copious among animal matters, and to be an oil peculiar to this department of nature.

§ V. Of Ambergrise.

AMBERGRISE is a concrete matter, of a soft tenacious consistency like wax, of a grey colour, marked with yellow or black spots, and of a strong, sweet smell, when it is heated or rubbed. It exists in irregular masses which are sometimes round, and consist of layers of different sorts, and either greater or smaller, according as the number united in the mass is greater or less. There have been pieces of it seen, which weighed more than two hundred pounds. This substance appears evidently to have once been in a liquid state, as various extraneous matters are found incorporated with it; such as the neb of the cuttle fish, bones of fishes, and other marine bodies. Ambergrise is found floating on the waters of the ocean near the Molucca Isles, Madagascar, Sumatra, and on the coasts of Coromandel, Brazil, Africa, China, and Japan. Some American fishermen informed Dr Schwediaur, an English physician, that they had often seen this matter among the excrements of that species of the whale which Linnæus calls *physeter macrocephalus*, in his intestines, or in a bag situated as is said, beside them, and probably the cæcum. Naturalists take notice of a good many varieties of ambergrise. Wallerius reckons the six that follow:

Varieties.

1. Grey ambergrise, with yellow spots.
2. Grey ambergrise, with black spots.

These two varieties are the most valuable and the most in request.

3. Whit

3. White ambergrise, of only one colour.
4. Yellow ambergrise, of no more but one colour.
5. Brown ambergrise, of a single colour.
6. Black ambergrise of a single colour.

It is to be observed, that these varieties are owing to a mixture of some extraneous substances.

There is a great disagreement among philosophers concerning the origin of ambergrise. By most of them, it has been considered as a bitumen,—a sort of petroleum, issuing from the rocks, and condensed by the action of the sun and the water of the sea. Others have imagined it to be made up of the excrements of birds nourished on odoriferous herbs. Others, again, have ascribed its origin to the froth thrown out by sea-calves, the excrements of the crocodile, &c. Pottmet and Lemery thought it a mixture of wax and honey, hardened by the action of the sun, and altered by the sea-water. M. Formey, who has adopted this opinion, supports it by an experiment which consists in digesting wax and honey. He asserts, that a product may thus be formed, of an agreeable smell, nearly the same with that of ambergrise.—Some English authors have considered ambergrise as an animal juice, deposited in bags situated near the root of the genital organ in the male whale; and others have imagined, that it is formed in the bladder of that cetaceous animal: But the nebs of cuttle-fishes found in this conerete juice, are sufficient to confute these opinions. Lastly, Dr Schwediaur, after examining a great many specimens of ambergrise, and receiving accounts concerning it from different na-

vigators, has concluded this substance to be formed in the alimentary canal of the *physeter macrocephalus*,—the species which affords the *spermaceti*, or white of the whale. He considers ambergrise as an excrement of this cetaceous animal, mixed with some parts of its food,—

1. Because fishermen find it in these whales : 2. Because it is common in the latitudes which they inhabit : 3. Because beaks of the cuttle-fish with eight feet, *sepia octopoda*, on which that animal lives, are always found in it : 4. Because he distinguished the black spots mixed through ambergrise to be the nebs of this polypous animal. 5. Lastly, Because the excrements of several quadrupeds, as cows, hogs, &c. exhale an odour similar to that of ambergrise, when kept for any length of time. His researches have raised this opinion of the Japanese, and of Kempfer, to an high degree of probability ; for which reason, we now rank this matter among the products of the animal kingdom.

Yet this substance, which has been analysed by Geoffroy, Neuman, Grim, and Brown, afforded to those chemists the same principles with bitumens ; that is to say, an acid spirit, a concrete acid salt, some oil, and a carbonaceous residue. But Dr Schwediaur observes, with great propriety, that the calculi of animals afford an acid, and that the existence of this salt is in favour of his opinion, for fat contains a great deal of it.

Ambergrise is stomachic, cordial, antispasmodic. It is used in doses of several grains, in certain drinks, or mixed with other substances, in pills. The odorous principle of this medicine is often too active, too penetrating, and liable to do harm. It is well known, that many persons cannot bear the smell of it without feeling their

nerves very disagreeably affected : it should therefore be administered very cautiously. It has been also considered as a powerful aphrodisiac. Some physicians, however, think that ambergrife may be prescribed in very copious doses, without producing any very powerful effects.

Ambergrife is chiefly used as an article of perfume, for the toilet : it is usually mixed with musk, the smell of which it weakens so as to render it much more agreeable. Yet every person is not fond even of this mixture.

As ambergrife is very dear, it is counterfeited and mixed with different substances. When genuine, it displays the following properties : It is scaly, insipid, and sweet-smelling ; it melts without rising in bubbles or froth, when exposed, in a silver-spoon, to the flame of a taper ; it swims on water, and does not stick to hot iron. Ambergrife which does not exhibit these properties, is to be considered as impure.



§ VI. *Of the Eggs of Birds.*

BIRDS' eggs, particularly hen-eggs, consist, 1. Of a bony shell, which has been shewn by M. Berniard, to contain a jelly, and calcareous phosphate ; 2. Of a membranous pellicle, immediately under the shell, which appears to be a tissue of fibrous matter ; 3. Of white ; 4. Of yellow, inclosed and suspended in the middle of the white. On this last substance the germ is supported.

The white of the egg is precisely of the same nature with the serum of the blood ; it is viscid and adhesive :

it communicates a green colour to syrup of violets; and contains carbonate of soda, in a naked state. By a gentle heat, it is coagulated into an opaque, white mass, which exhales the fetid smell of sulphurated or hepatic hydrogenous gas. This white, when coagulated and dried on a water-bath, affords an insipid phlegm, which putrefies, and acquires the dryness and reddish transparency of horn. By distillation in a retort, it affords ammoniacal carbonate, and empyreumatic oil: its coal contains soda, and a little calcareous phosphate. M. Deyeux likewise obtained a little sulphur from it, by sublimation.

The white of the egg, when exposed to the air in thin layers, rather becomes dry than putrid, and forms a sort of transparent varnish. It dissolves in water in any proportion. Acids coagulate it: This coagulum, when diluted in water and filtered, affords, by evaporation of the filtered liquor, a neutral salt, consisting of the acid which was employed, and the soda contained in this fluid. Alcohol likewise coagulates the white of the egg. Lime-water precipitates calcareous phosphate from it; and nitrate of mercury produces phosphate of mercury, which takes a rose-colour by desiccation.

The yellow, or yolk of the egg, consists mostly of albuminous matter, mixed, however, with a certain quantity of sweet oil; so that this mixture dissolves in water, and forms a sort of animal emulsion called *beza's milk*. When exposed to the action of fire, it is reduced to a mass, not so solid as that which the same agent forms from the white. When dried, it becomes soft, in consequence of the disengagement of its oil, which exudes from its surface. By submitting it to the press, in

this state, that oil is obtained, and is found to be sweet and fat, and of a smell and taste, in a slight degree, empyreumatic. The yolk of the egg distilled, after the extraction of this oil, affords the same products as other animal matters. Acids and alcohol coagulate it. The eggs of animals, as containing sweet oil, bear a great resemblance to the seeds of many vegetables; for these likewise contain a sweet oil, united in the same manner with a mucilage, and reduced to an emulsive state.

Eggs are very much used as an article of food. Their different parts are used in pharmacy and medicine. The shell is calcined, and employed as an absorbent. The oil of the egg is demulcent; it is applied externally, to cure burnings, chaps, &c. The yolk of the egg renders oils soluble in water, and thus forms lobochs: it is triturated with resins, camphor, &c. The white of the egg is of considerable use in pharmacy and confectionary, to clarify the juices of plants, wheys, syrups, and other fluids. It is also laid on paintings, which it preserves by forming a transparent varnish on their surface.

§ VII. *Of Ichthyocolla.*

ICHTHYOCOLLA, or fish-glue, is a substance partly gelatinous, partly lymphatic, which is prepared by rolling up the membranes that form the air-bladder of the sturgeon, and some other fishes, and leaving them to dry in the air, after twisting them into the form of a short cord,—in which we receive them. This matter affords a viscous jelly, when boiled in water. When left to macerate in that fluid, it may be unfolded and extended into a sort of membrane. It is never brittle, like

glues properly so called ; but its fibrous and elastic texture renders it always susceptible of being twisted. There is also a species of it prepared from a decoction of the skin, the stomach, and the intestines of fishes ; but this species is not equally valuable in the arts. All the products of other animal substances are obtained from ichthyocolla. It may be employed in medicine, as an emollient, in disorders affecting the throat, the intestines, &c. ; but several vegetable substances, possessing the same virtues, are commonly preferred. It is used in the arts, to clarify liquors, wine, coffee, &c. It attracts and precipitates all extraneous matters, altering their transparency.

§ VIII. *Of the Tortoise, the Frog, and the Viper.*

THE tortoise, the frog, the lizard, and the viper, are very much used in medicine : decoctions or soups, to which peculiar virtues have been ascribed, are prepared of them. In fact, animals whose component parts in general, are strong-smelling; and are found to contain a good deal of saline matter, by affording a considerable quantity of ammoniac, when distilled by a gentle heat after being triturated with potash ;—it would appear, that such animals must possess more numerous and more powerful virtues than others. Many physicians, however, doubt of the singularity of their virtues, and class them with other animals. Notwithstanding this opinion, turtle and frog soups are still administered in diseases attended with languor, in consump-
tions

tions without apparent cause, and in recovery from acute diseases,—and are often attended with good effects. It appears, that decoctions of these animal substances are peculiarly nourishing, light, and pleasant, and perhaps, are at the same time, possessed of a peculiar activity, as their strong smell and uncommon taste seem to indicate. Within these few years, the use of green lizards has been recommended in disorders affecting the skin, and cancers; but we may venture to doubt of their virtues.

Vipers are thought peculiarly active. The ancients talked much of their virtues in disorders affecting the skin, in disorders of the breast, and in chronical distempers in which the lymph is vitiated. One cannot help thinking, that viper soups must occasion depuration by the skin, by virtue of their powerful aroma. The powder and volatile salt of these animals are far from possessing the same virtues. To produce their full effects, these animals should be administered altogether as articles of food in the above diseases.

M. Thouvenel obtained from these animals, by chemical analysis, a jelly more or less light, either consistent or viscid,—an acrid extract, bitter and deliquescent,—a concrescible albuminous matter,—an ammoniacal salt,—and an oily substance, of a peculiar taste and smell, and sometimes soluble in alcohol, &c.

§ IX. *Of Cantbarides.*

CANTHARIDES, a medicine so valuable for its corrosive and epispastic powers, consist, according to M. Thouvenel, 1. Of a parenchyma, the nature of which he has not determined, and which composes one half of

the weight of the dried insect: 2. Of three drachms to the ounce of a reddish-yellow extractive matter, exceedingly bitter, which affords acid by distillation: 3. Of twelve grains to the ounce of a yellow, wax-like matter, to which the golden yellow colour of cantharides is owing: 4. Of sixty grains of a green, oily, wax-like substance; of an acrid taste, in which the smell of cantharides chiefly resides. This substance affords by distillation, a very pungent acid, and a concrete, wax-like oil. Water dissolves the extract, the yellow oil, and even a little of the green oil; but æther acts only on the last, and may therefore be successfully employed to separate it from the others. The virtue of cantharides is owing to this green wax. To extract this, together with the extractive matter, and by such means form a tincture charged with the substance of these insects, a mixture consisting of equal parts of alcohol and water, must be employed. When this mixed tincture is distilled, the alcohol retains a faint smell of cantharides; and the several matters contained in it are separated, as the evaporation takes place.

§ X. *Of Ants and the Formic Acid.*

THE acid of ants has been observed by Tragus, Bauhin, and several other botanists, who perceived the flower of chicory to become very red in an ant-hill. Samuel Fisher, Etmuller, and Hoffman, successively examined it. Margraf examined it with great care, and found that ants contain a peculiar acid, a fixed oil, and an extract. Messrs Ardvisson and Oerhne have made the most complete series of experiments on this acid.

This

This acid is obtained, especially from the great red ant, *formica rufa*, either by distillation in a retort, or by lixiviation with boiling water. This acid, when rectified, and a little concentrated, has a pungent smell: it is burning: its taste is pleasant, when diluted with a large proportion of water; it has therefore been proposed as a seasoning instead of vinegar. It speedily reddens all blue vegetable colours: it is decomposed by fire, which converts one part of its principles into carbonic acid; and by the sulphuric and the nitric acids, which also extricate from it the same acid. It detaches oxygen from the oxygenated muriatic acid: it is stronger than the sulphuric, the boracic, the carbonic, the acetous, or the nitrous acid. It forms a sort of æther with alcohol. The neutral salts which it forms with alkaline bases, have been examined by Messrs Ardwissen and Oerhne. Formiate of potash has been prepared by M. Thouvenel, by spreading cloths, previously dipped in potash, over ant-hills which had been opened up: the ants running upon the cloths, deposited upon them as much of their acid, and of the odorate principle which they exhale in great abundance, as was sufficient to saturate the fixed alkali. The lixivium formed upon these cloths, afforded, by evaporation, a neutral salt in flattened parallelograms, or prismatic columns, and not deliquescent.

Lime forms with this acid, a crystallisable and soluble salt. In a word, modern chemists consider the formic as a peculiar acid. Its affinities have been arranged in the following order, by Messrs Ardwissen and Oerhne: barytes, potash, soda, lime, magnesia, ammoniac, zink, manganese, iron, lead, tin, cobalt, copper, nickel, bismuth, silver, alumines.

Alcohol

Alcohol digested over ants, extracts from them a little volatile oil, which, with that fluid, forms Hoffman's *spirit of magnanimity*. By first boiling these insects in water, and then squeezing them, a fixed oil is obtained in the proportion of thirteen drachms to the pound. This oil is of a greenish yellow colour: it congeals sooner than oil of olives, and is much like wax. The water of the decoction affords, by evaporation, a reddish brown extract, of a fetid smell, acidulous and caseous, of a bitter taste, nauseous and acid. This extract is separable into two substances, by the successive application of water and alcohol. The parenchyma of ants separated from these substances, amounts to three ounces two drachms, in the pound.

§ XI. *Of Wood-Lice.*

WOOD-LICE, *millepedes, aselli, porcelli, onisci, &c.* exhibited to M. Thouvenel, when he analysed them, some properties peculiar to themselves. When distilled without addition, in a water-bath, they afforded an insipid alkaline phlegm, which sometimes produced an effervescence with acids, and turned syrup of violets green. They lost in this operation five eighths of their weight. When treated, afterwards, with water and alcohol, they afforded two drachms of soluble matter in the ounce; and of these more than two-thirds was extractive matter, and the rest an oily or wax-like substance. These two products are easily separable by æther, which dissolves the latter, without affecting the former. These matters differ from those of cantharides and ants, in affording more ammoniacal carbonate, and

no acid, when distilled. M. Thouvenel observes, on this subject, that among insects, wood-lice seem to bear the same relation to cantharides and ants, as oviparous quadrupeds and serpents bear to viviparous or real quadrupeds.

As to the neutral salts contained in these insects, their quantity is exceedingly small, and it is no easy matter to extract them. M. Thouvenel asserts, that wood-lice and earth-worms, *lumbrici*, always afforded him calcareous muriate, and muriate of potash; whereas, in ants and cantharides, these two bases, of which the first always appeared to be the most copious, were always combined with an acid possessing the same properties as the phosphoric acid. It is to be observed, that this chemist has not explained, in his dissertation, the methods by which he extracted those salts, or the processes by which he ascertained their nature.

Only cantharides and wood-lice are made use of in medicine. Wood-lice appear to act only as gentle stimulants and diuretics; and, according to M. Thouvenel's experiments, should be given in still stronger doses than are commonly prescribed of them. The juice expressed from forty or fifty living wood-lice, in a mild drink, or mixed with the juice of some aperient plants, may be given, with happy effects in the jaundice, serous disorders, *à serosa colluvie*, and coagulations of the milk, &c. Cantharides is one of the most potent of all medicines. M. Thouvenel himself had experience of the effects of the green waxen matter in which the virtues of these insects seem to reside: nine grains of it laid on the skin, raised a blister, full of serous matter, in the same manner as powder of cantharides. But what is most particularly
worthy

worthy of notice of all the facts respecting the virtues of this powerful remedy, is, that the spiritous tincture of cantharides may be applied, with the happiest success, externally, in dozes of from two drachms to two ounces and an half, in rheumatic and sciatic pains, and in the wandering gout. It heats the skin, quickens circulation, and occasions evacuation, by sweat, urine, and stool, according as it is applied on this or that part. Young physicians are to be cautioned against administering this medicine too rashly internally : It has been known to occasion flushings on the skin, spitting of blood, pains in the loins and bladder, dysuries, &c.

§ XII. *Of Honey and Wax.*

THE honey and wax prepared by bees, appear to belong to the vegetable kingdom ; for these insects collect the one of these substances from the nectaria of flowers, the other from the antheræ of their stamina. But they are elaborated in a particular manner : and besides, as they are the work of bees, their properties come most naturally to be examined in the history of these insects.

Honey is a matter perfectly like the saccharine juices which we have examined as belonging to vegetables. Its colour is white or yellowish ; its consistency sometimes syrupous, often soft and granulated, and its taste saccharine and aromatic. By alcohol, and even by water, with a little trouble, a real sugar may be obtained from honey. It affords in the retort, an acid phlegm, and an oil ; and its residual coal is spongy and porous, like that of the mucilages of plants. The nitric acid

converts

converts honey, as well as sugar, into oxalic acid. It dissolves very easily in water: it forms a syrup, and passes, like sugar, into a state of spiritous fermentation. It is a very agreeable article of food, and a softening, and slightly aperient medicine. Dissolved in water, and mixed with vinegar, under the name of oxymel;—it is frequently combined with some acrid plants, as in oxymel of squills, and of colchicus. It is the vehicle for many medicines which bear its name, such as honey of roses, honey of water-lily, mercurial honey, &c.

Wax is a concrete, oily juice, resembling solid fixed oils, such as butter of cacao, and still more vegetable wax. Although there can be no doubt that this substance is collected from the stamina of flowers, yet it is no less certain, that it undergoes some particular elaboration in the body of the animal; for Reaumur found it impossible to form flexible wax of the powder of flowers. The wax which composes the honey-combs of bees is yellow, and of an insipid taste. The action of the dew and the atmosphere whitens it, when exposed to it in thin plates: the oxygenated muriatic acid whitens it very speedily. It becomes soft by a gentle heat, melts, and forms a transparent oily fluid: by cooling, it becomes solid and opaque. When heated in contact with air, it kindles as soon as it becomes volatile: and this is the effect of the wick in candles. When distilled in a retort, it affords sebatic acid, and an oil which is at first fluid, but afterwards fixes in the receiver, and takes the consistency of butter. The quantity of the coal remaining is very trifling, and it is very difficult to incinerate. The butter of wax, after being several times rectified, becomes fluid and volatile.

White

112 *Silk-Worms, the Bombic Acid, and Silk.*

White wax is not liable to be altered by the air: it acquires a colour in the course of a certain time. It dissolves in oils, giving them consistency. When melted with these fluids by a gentle heat, it forms the medicines called *cerates*. Alcohol does not act upon wax. Acids blacken it: alkalis combine with it; and thus reduce it to a saponaceous state.

Wax is used in many of the arts; and in pharmacy, in the preparation of pomatum, ointments, and plasters.

§ XIII. *Of Silk Worms, the Bombic Acid, and Silk.*

THE silk-worm, especially in a chrysalis state, contains an acid liquor in a cell near the anus. M. Chauffier, of the academy of Dijon, obtained this acid both by squeezing the juice of the chrysalis through a cloth and precipitating the mucilage with alcohol, and by infusing the chrysalis in alcohol. When the acid is separated by alcohol, it carries it with it through the filter; and there remains on the paper an orange-coloured fat oil, a gummy matter, and a little gluten. To obtain the bombic acid in a state of purity, the alcohol must be distilled: on that occasion the alcohol is volatilized, and the acid only remains in the retort. The acid is very pungent, and of an amber yellow colour: its nature and combinations are unknown.

Many other insects likewise contain acid. It has been remarked by M. Bonnet, that the large caterpillar of the willow emits a liquor of considerable acidity. I have often observed the buprestes and staphylini to communicate a red colour to the blue paper with which

boxes containing them were lined. M. Chauffier has likewise obtained an acid from the grasshopper, the red bug, and the lampyris, or glow-worm.

Silk appears to be only a sort of dried gummy matter. It differs from vegetable substances, 1. In affording ammoniac by distillation: 2. In affording gas azote with nitric acid: 3. In affording a peculiar oil, which is separated from it when the nitric converts it into oxalic acid, as has been shewn by M. Berthollet. It seems to be a compound, consisting of a vegetable mucilage, with a peculiar animal oil, which renders it pliable, ductile, and elastic.

§ XIV. *Of Refin Lac.*

THE name of *gum lac* has been improperly given to a dark, red resinous substance, deposited on the branches of trees by a species of ants peculiar to the East Indies. This substance appeared to Geoffroy to be a sort of nidus in which those ants deposited their eggs. In fact, stick lac, when broken, appears full of small, regular cavities, or cells, containing small oblong bodies, which Geoffroy considered as embryo ants. He thought the colour of the lac owing to this animal matter. The lac he considered as a real wax: yet, its dryness, the aromatic smell which it exhales when burning, and its solubility in alcohol, render it more like resin than wax. According to the same writer, it affords a sort of butter by distillation. It is at present ascertained, that the lac is formed by a species of the coccus, and deposited on the branches of a species of the *croton*; which is named on that account *croton lacciferum*.—In commerce, stick

lac, grain lac, and shell lac, are distinguished from each other. It is to be observed, that many other colouring substances, particularly red animal or vegetable *fæcula*, when prepared in a particular manner for dyeing, are called *lac*. In the Levant, lac resin is used in dyeing cloth and skins. It is the basis of sealing-wax. A tincture is formed from it with spirit of cochlearia. It enters into troches of amber, dentifrice powders, and opiates, odorous pastills, &c.

§ IV. *Of Kermes.*

KERMES, or chermes, *coccus infectorius*, was formerly considered, by naturalists, as a tubercle or excrescence from plants. More accurate observation has since shewn it to be the female of an insect, which Geoffroy ranks among the hemiptera. The female insect fixes on the leaves of the holm-oak : after being fecundated, it extends itself, dies, and in a short time loses the insect form. It has the appearance of a brown cap, inclosing a great many eggs. This cap was formerly used in dyeing; cochineal now supplies its place. Kermes exhibits the same chemical properties with the cochineal. It enters into the confectio alkermes, &c.

§ XVI. *Of Cochineal.*

COCHINEAL, like kermes, was long considered as a vegetable grain. Father Plumier was among the first who discovered this to be a mistake. In fact, this substance is the female of an hemipterous insect, which differs from the kermes in retaining its form after fixing

on

on plants. The cochineal used in dyeing grows on the opuntia, or Indian fig-tree. It is collected in great quantities in South America. Geoffroy, who analysed it, found it to contain the same principles with kermes, and obtained ammoniac from it. The form of the insect may be distinguished after macerating it in water.—Cochineal is used in making carmine and in dyeing. It affords either a crimson or a scarlet colour, according as it is used. Being an extractive colouring matter, it cannot be applied to substances intended to be dyed, without a corrosive. It fixes easily on wool, and communicates to it a scarlet dye, by means of a solution of tin in muriatic acid, which decomposes the colouring extract, and contributes greatly to the brilliancy of the tinge. Macquer first taught to communicate this beautiful colour to silk. That celebrated chemist discovered a method of fixing the dye on this substance, by impregnating the silk with the solution of tin, before immersing it into the cochineal bath, instead of mixing the solution with the bath, as is done in dyeing wool.

§ XVII. Of Crab's Stones.

THE stony concretion, improperly called *crab's eyes*, *lapides cancerorum*, are found in pairs, in the interior and lower part of the stomach of these crustaceous insects. They are round, convex on one side, concave on the other, and disposed between the two membranes of the ventricle of the animal. As they are found only at the time when the crab changes its skin and stomach, and are gradually destroyed as the new covering of the insect gains consistency, it has been thought, with great

appearance of probability, that they contribute to the reproduction of the calcareous substance which forms the base of the shell of the animal.

These stones have no taste: they contain a small quantity of gelatinous matter. They are prepared for use, by washing them several times, and levigating them with a little water, to reduce them to a soft paste; which is wrought into little balls, and then dried. As the water with which these stones are washed takes up the gelatinous matter, what remains is nothing but an earthy substance. When prepared in this manner, they produce a lively effervescence with all acids, and are precisely of the same nature with chalk. Their only virtue is that of absorbing acid matters in the primary passages. That opinion which ranks this substance among aperient, diuretic, and cordial medicines, is equally ill-founded with many other fanciful opinions which have been entertained concerning the virtues of animal substances.

§ XVIII. *Of Coral.*

PRECISELY of the same nature is coral,—a sort of calcareous ramification, either white, rose-coloured, or red, which forms the basis of the habitation of the sea polypi. It is prepared in the same manner as crab's stones. Like those lapideous substances, it is of a calcareous nature. It enters into the confectio alkermes, pulvis gutteti, and amber troches. Numberless virtues have been ascribed to it; but unless combined with acids, it possesses no virtues, save those of a mere absorbent. Like crab's stones, it is often used, in a neutral
state

state, with vinegar, or lemon-juice, as an aperient, a diuretic, &c.

§ XIX. *Of the true Coralline.*

THE coralline, called *sea-moss*, is, as has been said, a peculiar habitation of polypi. In the retort it affords the same principles as animal colours: its taste is saltish, bitter, and disagreeable. It is used as a vermifuge, with good effects. To children it is given in a powder, in doses of four and twenty grains,—and to adults in doses of two drachms or more: an anthelmintic syrup is prepared with it: it enters into worm-powders. This common coralline must not be confounded with that which is at present called *coralline of Corsea, lemitto, or bel-zintocorton*: this last is a vegetable substance, a sort of fungus which forms a jelly with hot water.

C H A P. XV.

General Result of the Analysis of Animal Substances Comparison of Animal Substances with Vegetable Matters.

IN the fourteen preceding chapters, we have given the history of the present state of chemical knowledge with respect to animal substances. Those who have cultivated chemistry during the last twenty years will easily distinguish what the science has gained in this branch in the course of that period, and what amazing progress it has here made. Although many experiments still remain to be performed, and many discoveries to be made, in order to complete the history of animal matters; yet our present knowledge of them is much more considerable than what was formerly possessed: the proper road is, at least discovered; and we need no longer be afraid of wandering in a wrong direction. It now appears plainly how much the physics of animal nature may be improved by chemistry, and what important services medicine may expect from it, when the two sciences proceed hand in hand. If, after what is contained in the foregoing chapters, this assertion can be thought to need any additional proofs, these will be found in the following short recapitulation,

The

The matters which are called immediate principles of organic substances ; that is to say, such matters as are separated from organized bodies, directly, and without alteration ; bear a strong analogy to those which are extracted from vegetables. We find in animals, as well as in vegetables, extracts, a saccharine principle, insipid mucilages, acid and alkaline salts, fixed and volatile oils, resins, glutinous matter, an aromatic principle, and colouring substances. But notwithstanding this analogy, which was long ago observed, there are some remarkable differences between these immediate principles of the two kingdoms, the examination of which it is of sufficient importance to engage the attention of philosophers.

1. The extract and the saccharine matter, are not near so copious in animal as in vegetable matters.

2. The mucilages of animal are somewhat different from those of vegetable bodies : they are softer, easier dried, and capable of attracting moisture from the atmosphere ; they form into a jelly by cooling ; their taste is stronger, too, and they become sour, and putrefy much sooner.

3. The fixed oils of the animal kingdom are also different from those of vegetables. They are found in certain cells, in much larger quantities : they are always more or less concrete, and often susceptible of desiccation and crystallisation.

4. Volatile oils and resins are in general much less copious among animals than among vegetables. It would appear, that nature has carefully removed from the sensible and irritable organs of animals those acrid substances which would have constantly stimulated the fi-

bres : even in vegetables, they are disposed near the exterior tunics.

5. Albuminous matter, liable to concretion by heat, though to be found among the juices of vegetables, is less copious in them than in animals, all whose parts generally contain a considerable quantity of it.

6. The substance of the fibres of animals, though somewhat similar to the gluten of flour, is however more tenacious and elastic ; and besides, its proportion is so considerable, that were there no other difference between animals and vegetables, this alone might well engage the attention, and employ the industry of physiologists. All the muscles or organs of motion are composed of it ; and as animals display loco-motive powers which are not observed in vegetables, the parts in which those loco-motive powers reside, must be essentially different from the motionless bodies of plants.

7. But animal differ still more from vegetable matters, in the nature of the saline substances which they contain. Beside the salts and radical principles of saline bodies in animal matters, of the same nature with those which vegetables contain, such as lime, soda, the muriatic, oxalic, malic, benzoic, sebacic, and phosphoric acids : they afford also the lactic, saccholactic, lithic, formic, and bombic acids, whose nature is not known, but which do not appear to exist in vegetables. In animals, too, the principles from which ammoniac and the prussic acid are formed, exist in greater abundance than in vegetables ; and this is what most eminently distinguishes animal from vegetable matters. The principles requisite to the formation of ammoniac and the prussic acid, azote, hydrogene, and
carbone,

carbone, are even so copious in animal substances, that these compounds are very often ready formed, especially in animals a short time after death. I have found Prussian blue in putrid animal matters. I have even seen the blood of a sick person, which was very much altered, assume a bright blue colour, on exposure to the air. But it must be acknowledged, that vegetables likewise contain the principles of the prussic acid, though not in so great abundance. As to ammoniac, its being formed much easier, and much more frequently in animal matters than in vegetables, shows that the former contain its principles in much greater abundance than the latter: And in fact, M. Berthollet has proved, that those matters afford a much greater quantity of gas azote than the others, with the nitric acid. I have also proved, that after the gas azote is extracted from animal substances, they no longer afford ammoniac. It is therefore to this principle they owe their property of affording, either by a natural or an artificial analysis, a great quantity of this alkaline salt.

If we enquire, then, what are the more simple primary principles of which those immediate principles are composed; it will be found, that the only component principles of animal matters, as well as of vegetable substances, are, hydrogen, carbone, azote, and oxygen. These bodies, which, as they have not yet been decomposed, may be said to be in some measure elementary, appear to constitute, by various combinations with one another, oils, acids, mucilages, the fibrous part, &c. These more immediate principles, again, differ from each other only in the number and

the proportions in which the primary substances are combined in them. But, as animal matters, though consisting in general of the same principles with vegetable substances, are however really different in their properties; the difference must be owing to their containing the primary principles in different proportions. The superior proportion in which animal matters contain the principle of azote, accounts for a great many of those differences: it explains why animal substances afford a great deal of ammoniac by the action of fire; why they putrefy so soon; why they are necessary to the production of acid of nitre, &c.—The only thing which now remains to be enquired into, is, What change vegetable matters undergo, when they pass into animal bodies? For it is certain, that none but vegetable matters are proper for the nourishment of animals, or convertible into animal substance. It is first to be observed, that many of the immediate principles of vegetables pass unaltered into the bodies of animals, still retaining their peculiar nature,—or at least suffer but very little alteration; such, particularly, are various salts, fixed oils, &c. But the different sorts of mucilage, the gluten, and colouring substances, manifestly undergo a change of nature: the gummy matter becomes gelatinous, and the gluten is converted into the fibrous part; the base of azotic gas, or azote, becomes fixed in those substances, and combines with them in a large proportion: and the fixation of this principle seems to convert vegetable into animal matter. This change, and the formation of the different animal substances, should chiefly engage the attention of physiologists: this, in short, is the great problem with regard

to animal nature which remains to be solved. Analysis has already supplied some valuable facts towards this solution ; but many more are still wanting : and it is only by accurate chemical processes, that we can hope to obtain a sufficient number for the accomplishment of so desirable a purpose.

C H A P.

C H A P. XVI.

Of the Putrefaction of Animal Substances.

VEGETABLE matters, though liable to be decomposed, and even entirely destroyed by putrid fermentation, are, however, far from being so liable to that intestine motion as animal matters. The putrefaction of these last matters is much more rapid than that of the others, and exhibits very different phenomena. All the fluids, and all the soft parts of animals, are alike subject to it; but many vegetable matters seem to be entirely secure from it,—or, at least, it takes place on them very slowly, and with very great difficulty.

The putrefaction of animals, which one cannot help considering, with Boerhaave, as a real fermentation, is one of the most important phenomena in nature, and, at the same time, very difficult to understand. All the researches of philosophers, from the days of Lord Bacon of Verulam, who saw its importance, to the present time, have explained only a few circumstances, and examined only the general phenomena of putrefying matters. Beccher, Hales, Stahl, Pringle, Macbride, Gaber, Baumé, the respectable Author of the *Essays on Putrefaction*, and the Authors of the *Dissertations on Antiseptics*, which obtained prizes from the Academy of Dijon in the year 1767, have observed the phenomena which attend the putrid alteration of substances.

and described them with sufficient care. But, from the account which we are about to give of what is known concerning this matter, it will appear, that a great number of future experiments are necessary, to make us acquainted with all the particulars of what passes in this operation of nature.

Every fluid, or soft extract of an animal body, when exposed to the temperature of sixty-five degrees, or somewhat more, undergoes, with more or less rapidity, the following alterations: Its colour becomes pale, its consistency is relaxed; If a solid part, such as flesh, it becomes soft, and exudes a serous matter, the colour of which is very soon altered; its organization is destroyed; its smell becomes insipid and disagreeable; by degrees, this altered substance decreases in bulk, and its smell becomes ammoniacal. After this, if it be preserved in a close vessel, the putrefaction appears to proceed more slowly; none but an alkaline, pungent smell is felt from it:—the matter effervesces with acids, and turns the syrup of violets green. But, when air is admitted, the urinous exhalation goes off, and a peculiar, insufferable putrid smell rises from it with a degree of impetuosity: this smell continues for a long time, penetrates every where, and seems to affect the bodies of animals, like a fermenting substance capable of altering their fluids. This smell is corrected, and in some measure confined, by the ammoniac. After the volatilization of the ammoniac, the putrefaction proceeds with new energy: the putrefying mass suddenly swells, and appears filled with bubbles of an elastic fluid; but soon shrinks a-new: its colour is altered, and the fibrous texture of the flesh is now scarce distinguishable: it is changed into a soft
matter,

matter, of the consistency of a poultice, and either brown or greenish: its smell is insipid and nauseous, but acts with great energy on animal bodies. This odorous principle by degrees loses its strength: the fluid part of the flesh becomes, in some measure, consistent: its colour becomes deeper; and it is at last reduced to a friable matter, half-dry, yet somewhat deliquescent; which, by friction with the finger, breaks into a coarse powder, like earth. This is the last state that has been observed of the putrefaction of animal substances; they take a considerable time to reach this point, which is, however, sometimes longer, sometimes shorter. Eighteen months, nay two or even three years are scarce sufficient for the compleat destruction of the whole texture of an animal body exposed to the air; and the length of time which passes before the entire destruction of carcases buried in the ground, has not been yet ascertained. Not to speak of bodies which become dry in certain soils, and remain without suffering farther alteration,—many facts prove, that dead bodies buried together in great numbers in moist earth, are not destroyed even in the space of 30 years.

From these particulars, it follows, 1. That the circumstances necessary to excite and carry on the putrefaction of animal substances, are, the contact of air, heat, moisture, and rest or inactivity;—masses of animal matter, in order to putrefy, must be subject to all these circumstances: 2. That ammoniac is one of the products of putrefaction, and is formed during the fermentation; as it did not before exist ready-formed in those substances: 3. That the putrefaction, accomplished by an internal motion peculiar to organized bodies, may be compared,

pared to the action of fire, as has been remarked by M. Goddard; and considered as a spontaneous decomposition, as thinks M. Beaumé; differing from that action only in taking place more slowly: 4. That in this natural operation, the proximate principles of animals react on each other with the help of water and heat, which first excite the emotion; and accordingly, the newly-formed volatile matters are, by degrees, dissipated, in the order of their volatility, till nothing is left at the end of the putrefaction, but an insipid, and seemingly earthy residue: 5. That the putrid exhalation, the character of which is so well distinguished by the olfactory nerves, and which acts with such energy on the animal œconomy, is to be considered as one of the principal products of putrefaction, since it is peculiar to this operation, and not observed in any other natural phenomenon; and since, besides, it appears capable of exciting a putrefactive emotion in all other animal substances exposed to its action. As to the nature of this fugitive odorous substance; it is particularly on this point that our researches have made but small progress, and should be farther prosecuted. What we know of it, proves it to be extremely volatile, subtle, and penetrating in its nature; and that pure air, water in a large proportion, and acid gases are capable of moderating its effects. Although it must not be confounded with carbonic acid gas, a great deal of which is disengaged from putrefying bodies, and to the disengagement of which alone Macbride ascribed the cause of this natural phenomenon; and although it must not be considered as resembling either the hydrogenous gas which is disengaged from putrefying bodies, or the luminous

luminous matter which sparkles on the surface of putrid animal fibres, and renders them phosphoric; yet it cannot be denied, that there subsist between it and those substances some pretty strong relations, as it invariably accompanies them, is equally subtle and volatile, and acts with the same energy on the organs of animals.

We may observe, with M. de Boissieu, that there are four different degrees in the putrid fermentation of animal substances.

The first, which that philosopher calls *tendency to putrefaction*, consists in a slight alteration, which appears to take place by the diffusion of a sort of musty smell, and the softening of the substances.

The second degree, that of *putrefaction commencing*, is sometimes indicated by marks of acidity. Matters in this degree of putrefaction, lose a part of their weight, become soft, and give out serous matter, if in close vessels; but, if exposed to the open air, they rather become dry and dark-coloured.

In the third degree, that in which *putrefaction has made some progress*, the putrescent matters exhale an ammoniacal smell, mixed with a putrid and nauseous smell: they are then dissolved, and their colour more and more altered; and they at the same time suffer a loss of weight, and decrease in bulk.

Lastly, the fourth degree, that in which *putrefaction appears completed*, is distinguished by the ammoniac's being now entirely dissipated, and no trace of it remaining: the fetid smell is now fainter, and the weight and bulk of the putrefied substances are considerably diminished: a gelatinous mucous matter is separated from

them ; they become gradually dry, and are at last reduced to a friable earthy matter.

Such are the general phenomena observable in the putrefaction of animal substances ; but they are far from taking place uniformly in all instances of the putrefaction of animal substances. In the first place, there is a wide distinction between the manner in which parts of the living bodies of animals putrefy, and that in which this change takes place on dead carcases. In the former, the vital functions modify the phenomena of this alteration in a particular manner : physicians have frequently occasion to observe the differences between these two states of animal bodies, in respect to putrefaction. Besides, every different humour, every different solid part in an animal body putrefies in a peculiar manner. The muscular, membranous or parenchymatous texture of the organs,—the oily, mucilaginous or lymphatic nature of the humours,—their consistency,—their state with respect to that of the animal to which they belong,—all influence the emotion of putrefaction, and modify it in a thousand different ways, which it would perhaps be impossible to discriminate. Lastly, the state of the air, its temperature, its elasticity, its weight, its dryness or moisture, the particular local situation of the putrefying substance, and the very form of the vessel in which it is contained, are all likewise to be taken into account ; for all these circumstances contribute to diversify the phenomena of this spontaneous decomposition of bodies. It must therefore be acknowledged, that we are not yet acquainted with more than the outlines of the history of the putrefaction of animal substances ; and

that, to fill these up, a long series of researches and experiments is requisite.

Those phenomena of putrefaction which *have* been observed, shew that it is owing originally to water: most probably, that fluid is decomposed; and its oxigene combining with the azote of the animal substances, thereby produces the nitric acid which they are so frequently found to contain; and its hydrogen, again, may unite with another part of the azote, which is very copious in those matters, to form the ammoniac that is disengaged. The oily principle is separated, and remains longest unaltered. The calcareous phosphate, and phosphate of soda, in union with a portion of pure carbonaceous matter, and perhaps a little fat matter, seem to compose the apparently earthy residue of putrefied animal matters.

We have as yet described only the phenomena which take place on animal matters, when they are decomposed by putrefaction in the open air. As the phenomena of that decomposition in different media, tend to illustrate the revolutions which take place on our globe, let us consider, for a little, what happens to those matters, when they putrefy in water, or under ground.

The changes which take place in water are not quite the same with those above described. Animal bodies immersed in that fluid, first swell: elastic fluids are next disengaged from them: the water dissolves a great part of their principles, decomposes another part, and disperses those constituent principles over large masses of water: accordingly, some nations have exposed their dead carcases in rivers, and trusted to the waters for their destruction.

Different

Different phenomena take place when animal bodies are buried under ground. Observations, most of which were accidentally made, have shewn, that they are more rapidly or more slowly destroyed, according to the nature of the soil. Bodies are sometimes found to be totally destroyed in a little time; and sometimes they are found in a good state of preservation, even after lying a long time under ground. It may be easily conceived, that where the earth is very porous and light, and the animal matter disposed near the surface, air, and especially water, will then obtain easy access, and contribute to its decomposition. In opposite circumstances, the decomposition must naturally be much slower. Dry earth, for instance, absorbs water from bodies, renders them dry, and converts them into mummies. A sandy soil, in which bodies are exposed to the impression of a scorching sun, produces a similar effect, giving them a degree of hardness which renders them secure against destruction for ages. Argillaceous earth, again, retains water, and therefore favours the putrefaction of bodies. In cases in which it takes place, either sooner or latter, the fluids and solids are at last reduced almost entirely into gas azote, carbonic acid gas, hydrogenous gas, and ammoniac gas. All these elastic fluids, as they filtrate through the earth, are in part stopped in their progress, and rendered fixed; and accordingly render the mould black, fat, and fetid. These products of putrefaction saturate the mould in some measure, till they are at length carried off by the dissolving action of water and air, evaporation by heat, and absorption by vegetables. Thus, nature, by a slow

1 2

decomposition,

decomposition, reduces animal bodies, after they are deprived of life, into more simple substances, fitted to enter into new combinations.

This decomposition considered, as it takes place, all over the globe, at once, on the earth, in the air, and in water, gives rise to some important changes in nature, which philosophers should observe and ascertain. When we observe the wide extent of the sea, and the immense number of animals by which it is inhabited, it appears, that vast quantities of animals perish in it, which, by their spontaneous decomposition, must give rise to a number of phenomena that have been, as yet, but too little examined. What becomes of all those remains of animal bodies? What successive revolutions do they undergo? Sea-water is known to contain muriate and sulphate of soda, lime, and magnesia: No doubt, muriatic acid, magnesia, lime, and soda, are continually forming in this laboratory; nay; perhaps, the formation of many of these substances may be carried on by marine animals, during their lives; but others can be owing only to the decomposition of the same animals after death. It cannot be denied, that the strata of calcareous matters, which compose, as it were, the shell or crust of our globe over a very considerable part of its surface, have been originally produced from the remains of skeletons of marine animals, more or less broken by the action of the waters; that those strata have been primarily deposited at the bottom of the sea; and that bitumen, and pit-coal which is deposited in very thin and extensive strata, both of which substances occupy a part of the globe, have been originally produced in this manner. In the seas, therefore, there is a decomposition

position of water constantly carried on : innumerable agents are ever separating its principles, and suffering alterations themselves. Immense masses of chalk, from time to time deposited on the bottom, absorb and fix, that is, convert into solid substance a part of the liquid with which that capacious reservoir is constantly filled.

From these reflections on the decomposition of animal substances, in the earth, the air, and the waters, with all the assemblage of facts which chemistry supplies concerning it ; it follows, that the exterior strata of the globe are now different from what they originally were: that it is increasing in solidity and extent by the successive and uninterrupted accumulation of calcareous matter from the destruction of animal bodies : that the soil of the earth which we inhabit is modern and facitious : that minerals are not to be considered as forming a part of *this* soil : that it has been produced from a slow decomposition of animal and vegetable bodies : that water is constantly diminishing in quantity, and assuming a new form : that one part of decomposed water forms one of the bases of animal and vegetable bodies : that another part enters, in a solid form, into the calcareous strata of the globe : that the atmosphere must have been influenced and modified by all those changes : that vegetables are continually influencing the state of atmospheric air ; and that the light of the sun acts an important part in the production of these mutual alterations. Although it may appear impossible to determine the length of time in which the decomposition of water, vegetation, fermentation, putrefaction, the formation of saline-matters, bitumens, and calcareous substances, and their modifications, have been successively carried on ; yet

the modern discoveries with which chemistry and natural philosophy have been enriched, shew, that those phenomena have taken place at different periods ; that they continue to modify the present state of our planet : And that, if matter be, as great philosophers assert, only one substance, as to its mass and intimate nature ; yet its form is continually varying by new combinations, and gradually experiencing great revolutions ; of which modern chemistry, and modern chemistry alone, can ascertain the cause, and may one day determine the ultimate effects.

CONT.

CONTINUATION

Of the ANIMAL KINGDOM.

*Of the Methodical Classification and the Natural History
of Animals.*

AS the inferior animals on our globe are so numerous, it would be impossible for mankind to distinguish them from one another, or gain any considerable knowledge of their nature and habits, if they did not exhibit remarkable differences, which render it easy to establish distinctions among them. Naturalists have always been sensible of the utility of those differences; and by dividing animals according to them, either into more or fewer classes, have happily formed what are called *methods*. Though it be certain that no such classifications exist in nature, and all the individuals which she has produced, form one continued, uninterrupted series; yet they must be acknowledged to assist the memory, and to form truly useful guides in the study of natural history. Methods are therefore to be considered as instruments suited

to our weakness, which may be happily made use of in tracing the wide field over which the stores of nature are strewed. The divisions which Aristotle established, were very general and simple; but his ingenious reflections on the internal and external organs of animals, formed the basis on which most of the first naturalists who attempted methodical divisions—such as Aldrovandus, Johnston, Charleton, Ray, &c. established them. Those naturalists have been succeeded by a number of others, by whom their methods have been improved, and much added to the knowledge which they had collected. Among the latter, those whose works are the most worthy of being studied, and from which what follows here on this subject is borrowed, are Messrs Klein, Arthedi, Briffon, Daubenton, Geoffroy, &c.

After man, the organization of whose body, and the intelligence with which he is endowed, entitle him to be ranked at the head of all the animals inhabiting our globe, in a separate class,—all the other animals may be arranged in eight classes:—Quadrupeds, Cetaceous Animals, Birds, Oviparous Quadrupeds, Serpents, Fishes, Insects, and Worms, with which may be associated Polypti.

These classes might perhaps be rendered much more numerous. But, with the divisions, the difficulties of the study would be increased: and this is to be carefully avoided, in an artificial method; as such a method must owe all its value to simplicity and perspicuity. M. Daubenton, who has laboured much on the classification of animals, has arranged them in the same manner; and, under each class, has considered the structure of the principal parts of the animals contained in it; shewing,
that

that from man to the worm, animals become gradually more imperfect in their organization. (*See Table I. at the end of this volume.*)

In the history of animals, there are two principal objects of attention : 1. Their external forms, and the methods founded on those forms : 2. Their internal organs, and the functions for the performance of which they are destined. These two distinct objects we shall consider in two separate Sections.

S E C.

SECTION I.

A Sketch of the different Methods of the Natural History of Animals.

ARTICLE FIRST.

Of Quadrupeds. ZOOLOGY.

QUADRUPEDS are animals with four feet, whose bodies are generally covered with hair. They respire by lungs, like the human species: they have also a heart, with two ventricles: they are viviparous. Their structure, more than that of any other animals, resembles the structure of the human body. Some of them, such as the ape, and a few others, have even been ranked by Linnæus in the same class with man. That naturalist gives this class of animals the name of *mammalia*,—comprehending, also, cetaceous animals, because these, too, have breasts, and suckle their young.

Although

Although this class of animals may seem to be nearly of the same order with man ; yet, between the two, there are some striking differences, which we may here enumerate :—The horizontal disposition of their bodies, the form of the extremities, the thickness, the stiffness of the skin—which is either covered with hair, or with a hard and corneous crust ; the prolongation of the back-bone into a tail ; the flat, horizontal form of the anterior part of the cranium, the length and breadth of the ears, the extreme length and oblique disposition of the bones of the nose and the upper jaw : the union of the fingers ; the immobility of the bones of the fore-arm on one another ;—these are all properties in which this class of animals differs from the human species. The disposition of the human body, again, is elevated and perpendicular ; the bone of the radius is moveable upon the ulna, the fingers are separate, the thumb placed opposite to the other four, and the skin smooth and thin.—This difference of structure must evidently improve the sensibility of human beings, and render them much superior to the most perfect of the other animals. The anatomy of their internal organs, and the history of their functions, will corroborate still farther these important considerations.

Ancient naturalists, at the head of whom are Aristotle and Pliny, did not think of distinguishing quadrupeds any other way but by the regions which they inhabited : Accordingly, such is the inaccuracy of their descriptions, and such the uncertainty of those characteristics which they have pointed out, that we are often at a loss to discover what animals they allude to. Naturalists, sensible of the inconveniences

attending

attending this method, have since adopted a very different mode, in their descriptions of the objects of natural history. From the exterior form of the most conspicuous parts of animals, they have assumed characteristics easily discernible, and sufficient to establish certain distinctions. We shall here give an account of only three artificial methods of arranging quadrupeds: those of Messrs Linnæus, Klein, and Brisson.

The METHOD of LINNÆUS.

LINNÆUS divides animals with teats, *mammalia*, into seven orders. The first comprehends those which he calls *primates*, the characteristics of which are incisory teeth in both jaws; in the upper-jaw, always four teeth; two teats on the breast; and the arms separated by a collar-bone. In this order there are four genera; namely, man *homo*, the ape *simia*, the maki *lemur* or *prosimia*, and the bat *vespertilio*. It must be acknowledged, that this method does not very well agree with nature; for there is so wide a difference between man and the bat, that it is almost shocking to class them together.

The animals of the second order are denominated *bruta*. Their characteristics are, the want of incisive teeth, feet with strong hooves, and slowness of motion in walking. This order contains six genera; the elephant *elephas*, the sea-cow *trichechus*, the sloth *bradypus*, the ant-eater *myrmecophaga*, the philodotus *manis*, and the tatou, or *dasypus*. There is a wide difference between the two former genera, and the latter four.

In the third order, which the Swedish naturalist denominates *fera*, wild beasts, he includes all animals with paws, whose incisory teeth are of a conical form, and generally in the number of six to both jaws,—the canine teeth very long, and the molares not flattened,—their feet armed with claws,—and who, in their habits of life, are rapacious and devour their prey. In this order, there are ten genera; the sea-calf *phoca*, the dog, *canis*, the cat *felis*, the ferret *viverra*, the weasel *mustella*, the bear *ursus*, the *didelphis*, the mole *talpa*, the mouse *fores*, and the hedgehog *erinaceus*.

The fourth order, intituled *glires*, the dormice, is distinguished by the following characteristics. The animals belonging to it have two incisory teeth on each jaw, but no canine teeth. On their feet, they have claws which fit them for leaping. They gnaw the bark and roots of trees, &c. This order comprehends six genera; the porcupine *bistria*, the hare *lepus*, the beaver *castor*, the rat *mus*, the squirrel *sciurus*, and the American bat, named by Linnæus *noctilio*.

Under his fifth order, *pecora*, this naturalist comprehends all those quadrupeds which have incisory teeth on the under-jaw, but none on the upper, which have their hooves divided, and which chew the cud. The camel *camelus*, the animal which affords musk *moschus*, the stag *cervus*, the goat *capra*, the sheep *ovis*, and the cow *bos*, are the six genera of which this order consists.

Under the denomination of *belluæ*, the sixth order, he comprehends quadrupeds with obtuse, incisory teeth, and hooves on their feet. The four genera of which this order consists, namely, the horse *equus*, the river-horse *bippopotamus*, the hog *sus*, and the unicorn *rhinoceros*,

ceros, are sufficiently distinguished from one another, by the number of their teeth, and the form of the feet.

Lastly, the seventh order, comprehending cetaceous animals, *cete*, is distinguished from the other orders by the form of the feet of these animals, which resemble fins. As, however, we agree in opinion with several modern naturalists, who think that cetaceous animals should be ranked in a particular class, we shall speak of them after quadrupeds.

The method of Linnæus appears to be in many instances defective;—not only in bringing man and the bat, &c. improperly together, and in dividing with equal impropriety animals so nearly resembling each other as the rat and the mouse, &c.; but its divisions are far from being sufficiently numerous; nor will they help the student to distinguish any particular quadruped: And this is what must constitute the great merit of a system of arrangement;—this is indeed the only advantage that can be gained by it.

KLEIN'S METHOD.

KLEIN divides quadrupeds into two great orders; the first, comprehending quadrupeds with hooves, *pedes ungulati sive cheliferi*; the second such as have their feet digitated, *pedes digitati*.

The first order is divided into five families, which are distinguished from each other according to the division of their hooves. The first family, called *monochela*, (in French *solipede*) *single-hoofed*, comprehends the genus of the horse.—The second, the individuals of which are distinguished

distinguished by the name of *dichela*, consists of those quadrupeds whose hooves are parted into two, or bifurcal *bisulci*. Some of these, such as the bull, the ram, the buck, the stag, the giraffe, &c. have horns, Others again, such as the boar, the hog, the babyroussa, are without horns.—The third family contains the *trichela*, or animals which have the hoof parted into three; of which there are none but the *rhinoceros*.—In the fourth family, whose peculiar characteristic is, to have the hoof parted into four, *tetrachela*, there is only the hippopotamus.—The elephant, the only animal whose foot is parted into five divisions, constitutes the fifth family, *pentachela*.

The second order of quadrupeds, containing those which are digitated, is likewise divided into five families. The first consisting of animals with two toes on the foot, *didactyla*, comprehends the camel, and the sloth of Ceylon.—The second family, animals with three toes on the foot, *tridactyla*, consists of the sloth and the ant-eater.—In the third, Klein comprehends, under the name of *tetradactyla*, animals with four toes, tatous or armadilloes, and the *cavia*, which seems to be a sort of rabbit.—The fourth family, characterised by having five toes, *pentadactyla*, is more numerous than any of the former families: it contains the rabbit, the squirrel, the dormouse, the rat and the mouse, the didelphis, the mole, the bat, the weasel, the porcupine, the dog, the wolf, the fox, the *coati*, the cat, the tiger, the lion, the bear, and the ape:—a very considerable number of species are comprised under these different genera. It is to be observed, that in all these characteristics, taken from the form of the feet, Klein, in distinguishing the families,

families, considers only the fore-feet. Lastly, the fifth family of digitated animals consists of animals whose feet are irregular in respect to the number and division of their toes, *anomalopoda*; such as the otter, the beaver, the sea-cow, and the phocas or sea-calf.

The same objection may be made to Klein, as to Linnaeus. The families are, indeed, sufficiently distinguished from one another; but the genera, especially those of the fourth family of digitated animals, cannot be well discriminated in his system.

METHOD of M. BRISSON.

M. BRISSON has avoided most of the defects of other systems, by combining together all the characteristics which had been assumed by preceding naturalists:—The number of the teeth, the want of teeth, the form of the extremities, the shape of the tail, and the nature of the appendices—such as horns, scales, and prickles. His system cannot be denied to be the most compleat, and the best contrived to help us to distinguish any quadruped, and refer it to the genus to which it belongs. His divisions are here exhibited in a table: it contains the generic characteristics of animals; and is very simple and easy.—*See Table II. at the end of this volume.*

ARTICLE

ARTICLE II.

Of Cetaceous Animals.

CETACEOUS animals, are great animals inhabiting the seas, which are enabled, by the structure of their lungs and blood-vessels, to live under water,—as we shall explain more particularly in the history of respiration. Being viviparous, they resemble quadrupeds in the structure of their breasts, and of their internal organs in general; but the form of their extremities is different,—as these spread into fins: And they have, besides, two apertures in the upper part of the head, through which they spout water to a considerable height. These holes are called by naturalists *spiracula*. M. Daubenton translates this word (*events*) *vents*. These animals are far from being equally numerous with quadrupeds. M. Brisson distinguishes them, 1. into Cetaceous animals wanting teeth, such as the whale *balæna*; 2. Cetaceous animals which have teeth only in the upper-jaw, such as the *cachalot*, *monodon vel monoceros*; 3. Cetaceous animals with teeth only in the under-jaw, such as the narval or unicorn of the sea, *phylæter*; 4. Lastly, Cetaceous animals having teeth in both jaws, such as the dolphin, *delfbinus*.

ARTICLE III.

Of Birds. ORNITHOLOGY.

BIRDS are animals with two feet, which move through the air by means of wings, are covered with feathers, and have bills of a corneous substance. Many facts concerning the forms of the bills, the structure of the feathers, the motions and the habits of these animals, are highly worthy of attention. The most important of those facts will be given in an abridgement of physiology, which is to follow in this volume. At present, we are only concerned to give the external characteristics by which the animals are distinguished, and systematically arranged. The first philosophers who treated of this part of natural history, established no distinctions among birds, but such as depended on their inhabiting in different situations. They distinguished them into birds of the woods, birds of the plains, birds of the thickets, sea-fowls, river-fowls, and birds frequenting lakes, &c. Others have distinguished them by the species of food on which they live, into birds of prey, granivorous birds, &c. &c.

But the moderns who have formed systems of natural history, have taken a very different way of establishing characteristic differences among them. Linnæus has divided them, by the form of the bill, into six orders, in the same manner as quadrupeds, with which he compares them. But those divisions do not appear to be sufficiently

sufficiently numerous; especially as the number of the species of birds is much more considerable than that of quadrupeds. Buffon makes the quadrupeds which are known, amount to two hundred different species; but the species of birds to fifteen hundred or two thousand. —We shall here speak only of Klein's and M. Brisson's systematical arrangements of birds.

Klein divides birds into eight families, according to the form of their feet. The first, under the name of *didactylæ*, consists of such as have two toes on the foot: —the only bird belonging to this division is the ostrich. —The second consists of *tridactylæ*, such as the cassiary, the bustard, the lapwing, the plover.—The third, the *tetradactylæ*, have two toes before, and two behind, such as the parrot, the woodpecker, the cuckoo, and the king's-fisher.—The fourth comprehends the *tetradactylæ* which have three toes before, and one behind, This family is more numerous than any of the rest: it comprehends both diurnal and nocturnal birds of prey, ravens, magpies, starlings, thrushes and blackbirds, larks, red-breasts, swallows, tom-tits, woodcocks, bulfinches, rails, crossbills, gallinaceous fowls, herons, &c. —The fifth family contains *tetradactylæ* having their three fore-toes connected by a membrane, but the toe behind separate. These birds are called *palmipedes*. This family consists of geese, ducks, sea-mews, and divers.—The sixth comprehends those *tetradactylæ* which have all the four toes connected by a membrane. They are called in Latin *planci*. The pelican, the cormorant, the *fool*, and the anhinga, are ranked by Klein in this family.—The seventh consists of those who have only three toes, and these connected by a membrane:

they are denominated *tridactyla palmipedes*. The guillemot, the penguin, and the albatross, belong to this family.—Lastly, the eighth consists of *tetradactyla* having on their toes fringed or scolloped membranes. They are called also *dactylobæ*. This last family consists of the *colimba* and the coot.—Klein's method, though it descends to more particulars than that of Linnæus, is still attended with numerous difficulties as to the distinctions of the genera; especially those of the fourth family. We therefore think M. Brisson's preferable. The last, indeed, as the author has made use of the different characteristics in the same manner as in his classification of quadrupeds, appears at first sight to be very complicated; but when reduced to a table, as we have done with it, it exhibits, at one glance, all the divisions of which it consists; and any particular bird may be easily distinguished, by tracing those divisions.—See Table III. at the end of this volume.

ARTICLE IV.

Of Oviparous Quadrupeds.

LINNÆUS, in his system, arranged together, oviparous quadrupeds, serpents, and cartilaginous fishes, under the name of *amphibia*. But, M. Daubenton is of opinion, that the word *amphibia* cannot be properly applied to any class of animals: for it must mean animals which live either in air or in water, as long as they please; and there is no class possessed of this property: Were the denomination,

denomination, again, to be applied to all terrestrial animals capable of living for any space of time, however short, under water,—and all aquatic animals capable of living in the air,—all animals would then be amphibious. In the same class, but in two distinct orders, Linnaeus ranks both oviparous quadrupeds, and serpents; and those amphibious animals which practise swimming, he ranks among fishes.

In M. Daubenton's system, oviparous quadrupeds compose the fourth order of animals. Their organization is by no means imperfect: for they, like the quadrupeds, cetaceous animals, and birds ranked before them, have a head, nostrils, and ears situated within the head. But, the following characteristics distinguish this class from the three preceeding orders: 1. They have only one ventricle in the heart: 2. Their blood is almost cold: 3. They respire only after long intervals: 4. They are oviparous, and consequently without teats.—The last of these characteristics is common to them with the four following orders of animals. Lastly, no other animals but they, have four feet without hair.

M. Daubenton observes, that the differences among the various genera belonging to this order are so considerable, as to render it impossible to communicate any general notions common to them all. Of this he treats in the history of each particular genus, under the words, tortoises, lizards, toads, frogs, in the second volume of the *Natural History of Animals*, which forms a part of the *Encyclopædie Methodique*.

The classification and the characteristics which that celebrated naturalist has given of the order of oviparous quadrupeds, is one of the most complete and the best

executed parts of the natural history of animals : and I have, therefore, formed into a table, all M. Daubenton's divisions, from classes to species, as the number of the species is not above 100.--(See Table IV.) Since the publication of M. Daubenton's work, the Count de la Ceppe has published a very complete and accurate work on oviparous quadrupeds, in which he exhibits a peculiar method of arrangement. This method is laid down in the fifth table, which is extracted from M. de la Ceppe's work.

ARTICLE V.

Of Serpents.

SERPENTS form the fifth order in M. Daubenton's division of animals. These are sufficiently distinguished, by having their bodies covered with scales, and being without feet or fins. They have a head, nostrils, ears within the head, only one ventricle in the heart, and their blood is almost cold : they respire only after long intervals, and produce eggs like oviparous quadrupeds. Serpents have neither neck nor shoulders. The scales with which they are covered, are of three sorts : They are either rhomboidal, and rising over each other like tiles, to which form and disposition, Linnæus gives the name of *squamme* ; or else of an oblong square form, and disposed one beside another,—and these Linnæus calls *scuta* or plates ;—when very small, and still of this form,

form, they are denominated *scutella* or small plates: Or lastly, they form rings round the body of the serpent,—as in the *amphisbæna*.

Though serpents be without feet, yet they often move nimbly enough, by fixing the fore-part of the body, raising the middle, and then bringing forward the hinder part; they rest on the tail, and spring to a distance to attack their prey. They change their skin once or twice a year.

Some serpents are venomous. Of 131 species of which Linnæus takes notice, 23 are by that naturalist reckoned dangerous. All of these animals whose bite is dangerous, have, on each side of the upper jaw, a tooth considerably larger than their other teeth; at the root of which is a cell filled with a peculiar fluid, which they pour into the wound through a groove in the tooth.

It cannot now be considered as a matter of doubt, after the testimony of so many respectable authorities, that there are species of serpents of a very extraordinary size. M. Adanson, from a number of very accurate facts, fixes the size of the largest serpents, at forty or fifty feet in length, and a foot and an half in thickness.

Of all naturalists, M. Laurenti has entered the most minutely into the classification of serpents. He distributes them into 17 genera. But M. Daubenton rejects the system of this naturalist, because it is so exceedingly difficult to recognise the distinctive characters; adopting in preference to it, that of Linnæus.—The sixth table, at the end of this volume, contains the divisions and characteristics of serpents, from genera, to no fewer than one hundred and twenty-seven species which have been enumerated by M. Daubenton.

ARTICLE IV.

Of Fishes. ICHTHYOLOGY.

FISHES are a very different sort of animals from those which we have hitherto been considering: the structure of their internal organs is altogether peculiar, as will be shewn in our abstract of physiology. They differ from other animals, in having, instead of feet, fins which enable them to move in water,—and in respiring water instead of air. It is much more difficult to gain a knowledge of fishes, than of other animals; and accordingly, the natural history of fishes is very imperfect.

In order to understand the methodical division of these animals, which we are about to propose from Artedi, Linnæus, and M. Gouan, it will be necessary for the reader to take a hasty view of the anatomy of the exterior parts of their bodies. The bodies of fishes may be divided into three parts: the head, the trunk of the body, and the fins.

The heads of these animals are of various forms:—Either horizontally or laterally flattened, or round: either naked or scaly: smooth, or overspread with asperities, tubercles, &c.—The lips have been observed to be either fleshy or bony, with appendices or barbels, soft, and very moveable: the teeth are fixed, either to the jaws, the palate, the tongue, or the gullet: their eyes are two in number, motionless, and without eye-lids; the channels of their nostrils are double on

both sides: they have an opening at the gills or bronchiæ: they are provided with bones, either round, triangular, or square, to shut this opening: the bronchial membrane is placed under these, and supported by several other bones, in the form of a bow, the number of which varies from two to ten. This membrane folds back on the bones above it; and it is an object of importance to examine the varieties of its structure,—as the characteristics of genera are often taken from the number or form of the radii.

The form of the trunk varies, as well as that of the head. It is either round, or globular, or oblong, or flat, or angular. In it are to be observed the lateral lines, which seem to divide each side of the body into two parts:—The thorax, situated immediately below the gills, at the upper extremity of the trunk, and filled with the heart and bronchiæ:—the belly, the sides of which extend from the head to the tail, and which contains the stomach, the liver, the air-bladder, and the genital organs:—the orifice of the anus, common to the intestines, the bladder, and the organs of generation:—and lastly, the tail, which terminates the trunk, and of which the form and size are various.

The fins, *pinnæ natatoriæ*, consist of membranes, supported on small radii, of which, some are hard and bony, and terminate in a thorny point,—which has procured to the fishes to which it belongs, the name of *acanthopterygii* from Artedi; others are flexible, soft, obtuse, and seemingly cartilaginous,—and characterise the fishes to which they belong, as *malacopterygii*. The fins are distinguished into five sorts, according to their situations;

tions; dorsal, pectoral, abdominal, those of the anus, and of the tail.

The dorsal fin maintains the fish in equilibrium. It is diversified by situation, figure, number, proportion, &c.

The fins of the thorax are situated at the opening of the gills: they are two in number: they serve the purpose of arms, and sometimes even of wings; they differ in situation, extent, figure, &c.

The fins of the belly are more particularly worthy of notice; for, from their situation has the celebrated Linnæus taken his distinctive characteristics in classing fishes. These fins are situated on the lower part of the body, above the anus, and always lower and nearer each other than the pectoral fins. They are sometimes wanting; and as Linnæus compares them to feet, he calls such fishes as want these fins *apodes*. Most fishes however, are possessed of them; but they are not always inserted at the same place. When they are situated either before or immediately under the opening of the gills and the pectoral fins, both they and the fishes to which they belong, are called *jugular*. When fixed to the thorax, and behind the opening of the gills, they are called *thoracic*: And, in Linnæus's system, fishes of this structure are discriminated by the same name. Lastly, when placed under the belly, and nearer the anus than the pectoral fins, they are called *abdominal*; and, in like manner as before, communicate their name to the order of fishes which have them in this situation.

The fin of the anus is an odd one: it occupies, either in whole or in part, the region between the anus and
the

the tail. It is liable to varieties of form, number, and size. Yet, none but the golden-fish of China, are known to have two of these fins.

The tail fin is disposed vertically at the extremity of the body, and terminates the tail. The fish uses it as a rudder, moving it, so as to change the direction in which it swims, at pleasure. It is likewise subject to some varieties in its form, its adherence or connexions, its extent, &c.

After this account of the anatomy of the exterior parts of fishes, we may pass to the systematic divisions in which naturalists have arranged them. Before Artedi, no naturalist had attempted a systematic arrangement of fishes; although classifications of the other animals had been already formed. This philosopher was the first who offered to the world, a system of ichthyology formed on the nature of the fins, as hard or soft, pointed or obtuse, and on the form of the gills. He afterwards engaged in a design to extend the divisions by characteristics taken from other parts; but was prevented by a premature death, from accomplishing his design. Linnæus contrived to form a system of ichthyology, on the variations of the position of the fins of the belly: And M. Gouan, a celebrated professor of Montpellier, has very happily combined the two systems of Artedi and Linnæus. This naturalist divides fishes first into those whose gills are perfect,—that is to say, consist of an *operculum*, and a bronchial membrane regularly organized; and those whose gills are imperfect,—that is, which want either the operculum, or the bronchial membrane, or both. The first mentioned, are those distinguished by the form of their fins.—In fact, these parts
consist

consist either of hard, pointed bones, or of soft, and seemingly cartilaginous radii. These distinctions establish three different classes of fishes : 1. The *acanthopterygii* ; 2. The *malacopterygii* : and, 3. The *branchiostegi*. In each of these classes, the belly-fins being either wanting, or placed on the neck, on the thorax, or on the belly ; M. Gouan therefore divides each class into four orders : *apodes*, jugular, thoracic, and abdominal.

The distinctive characters of the genera, under these divisions, are taken from the form of the body, the head, the mouth, the bronchial membrane, and more especially the number of the radii which support that membrane.—*See Table VII.*

ARTICLE VII.

Of Insects. ENTOMOLOGY.

INSECTS are distinguished by the form of their body which seems to be divided into rings ; and by two moveable horns on the fore part of the head, called *antennæ*. Insects form one of the most numerous classes of animals, on account, no doubt, of their diminutive size ; for it has been observed that the smaller animals are, so much the more numerous are they. The history of these animals is one of the most agreeable and amusing branches of natural history ; perhaps, too, not the least useful ;
for,

for, in prosecuting it, many discoveries may be made, beneficial both to medicine and the arts.

Insects, in their manners, form, habitation, &c. display in miniature, almost the whole œconomy and characteristics of other animals. Some insects walk like quadrupeds; others fly like birds; some swim, and live in water, like fishes; and lastly some leap and trail along, like certain reptiles. This analogy might be even traced much farther, by examining, particularly, the structure of their extremities, mouth, and interior organs, &c.

Insects, considered as to external appearance, consist of three parts: an head, a corselet, or breast, and a belly.

The form, size, and position of the head are various. It is sometimes very large in proportion to the bulk of the insect, and sometimes very small: it is either round, or square, or oblong; either smooth, or overspread with small holes, or tuberculated, or covered with hair in certain places. On it are observed, 1. The antennæ, placed near the eyes, and consisting of several different, articulated, moveable pieces, like a thread, terminating either in a point, or in a knob: the form of the antennæ is to be always carefully observed; for it affords by its varieties, generic characteristics: 2. The eyes which are of two sorts, either with facets, or in a sort of network, smooth and small: these organs are sometimes very large, and sometimes small; their number varies: some insects have only one eye, and are distinguished as monocular; others, such as the spider, have two, five, or even eight: 3. The mouth, which consists either of short corneous jaws, placed laterally, and moveable

able towards the sides; or of a proboscis, either longer or shorter, dilated or spiral, &c.; or of a simple gap or orifice, &c. This part is often armed with small moveable appendices, denominated antennulæ or barbels, and either two or four in number.

The corselet is the breast of the insect, placed between the head and the belly. It is sometimes round, sometimes triangular, cylindrical, broad, and narrow, &c. It is to be considered as a sort of cube consisting of six sides; and its form is sometimes regularly cubic. The front, or anterior extremity, is hollowed for the reception of the head. In flies, for instance, the junction of the head to the body, at this part, is sometimes formed merely by a thread. The posterior extremity, again, is commonly round, and articulated with the first ring of the belly; sometimes it is joined to that part by a thread. The upper facet is sometimes flat and smooth, sometimes round, prominent, bearing appendices, tuberculated, and terminating in a jutting border: This forms what is called the bordered corselet, *thorax marginatus*.—The wings are fastened to the posterior part of this facet. It is well known, that most insects are provided with wings; but that their wings differ amazingly from each other. It may be of consequence, briefly to consider these diversities of the structure of the wings of insects; as naturalists have established on them the leading divisions of their classifications of these animals.

The wings of insects are either two or four in number. Insects having two transparent wings, such as the fly, the gnat, &c. have always, towards the part where the wing joins the body, and under it, a small filament terminating in a round button, called the *balance*; and
covered

covered with a concave, membranous appendage, called the *bowel*. In many insects, these two wings are very strong, twisted and plaited under hard, corneous, moveable sheaths, called *elytra*.—These sheaths are of various forms: some of them cover the whole belly; others are cut transversely, and cover only a part of the belly: some of them are hard; others soft: most of them have, near the place of their juncture, a small triangular piece soldered to the corselet, which is called *scutellum*; others want this small piece. Lastly, a number of insects with sheaths, have the elytra soldered so as to form seemingly but one piece, and motionless.

The wings are often four in number; they are then either membranous and transparent, as in the dragon-fly, the wasp, &c. or apparently sprinkled with a coloured dust, which, when viewed through the microscope, proves to be scales rising one over another, on the wing, as tiles on the roof of a house, *imbricatim*.

The lower part of the corselet is irregular in its form; it consists of several pieces glued one over another, and bears a part of the legs.—The number of the legs varies: Many insects have six legs; and others, such as the spider, have eight legs: some, again, have ten, like crabs; and lastly, there are some which have a still greater number. Wood-lice are observed to have sixteen; and some species of the scolopendra have from seventy to one hundred and twenty on each side. According to M. Geoffroy, the legs of those insects which have only six or eight, are fixed to the corselet; but such as possess a greater number, have a part of them inserted in the rings of the belly.

The

The leg of an insect consist always of three parts :— the thigh—the part next the body, the leg, and the tarsus. Beside these there is often an intermediate piece between the body and the thigh. The tarsus consists of several pieces or rings articulated one with another: the number of these rings varies from two to five. There are even some insects which have the tarsus larger in the fore, than in the hinder legs; which establishes an analogy between the structure of these small animals and that of many quadrupeds, which have more toes on the fore than on the hinder feet. M. Geoffroy, as we shall afterwards see, has assumed a part of this character for the basis of his systematic division of insects. The tarsus is terminated by two, four, or six small claws, and has generally, on the under side, several small brushes, or spongy clues, which enable the insect to adhere even to the most polished bodies, such as ice, &c.

On each side of the corselet, there are observed, one or two oblong, oval apertures, called stigmata, by which the insect respire.

The third part of the body of an insect, is the belly. It generally consists of corneous rings, or half-rings, en- chased in one another. Sometimes, no such rings are observed, but the belly appears to consist all of one piece. Female insects have usually larger bellies than the male. At the extremity of the belly are the parts of generation: On the sides, each ring but the two lowest, is perforated with a stigma. At the lower part of the belly, too, many insects bear their stings; of which, some are sharp-pointed, others serrated, and others of an auger form.—They use them as weapons of defence,
and

and as instruments for forming cells in which they may deposite their eggs.

The most singular phenomenon which insects exhibit,—which, more than any thing else, distinguishes them from most other animals,—is, their passing through different states by a sort of metamorphosis, before they become perfect insects. Some insects,—almost all those belonging to the class of *aptera*, suffer no such changes; but by far the greatest number of these animals are subject to them. The insect is not of the same form with its parent, when it issues from the egg; it is then a worm, either with or without legs; and, in this state, these animals exhibit great diversities in the head and the rings. In this first state, the insect receives the name of *larva*: under this mask, it eats, grows bigger, moves, and changes its skin several times. When it attains its full size, it changes its skin for the last time; and is now no longer a worm or larva, but in a totally different form; in which it is known by the names, *nymphæ*, *chrysalis*, *aurelia*.

M. Geoffroy distinguishes *nymphæ* into four different species.—The first bears no resemblance to an animal.—Only a few rings are observed on its under part; and above, only some very imperfect marks of antennæ, legs, and wings.—The skin of this species of nymphæ is hard and cartilaginous; and only some of its rings are moveable.—Such are the nymphæ of butterflies, &c.

The second species of chrysalis exhibits the parts of the perfect animal, wrapped in a very thin soft skin.—Like that of the former species, it is immoveable. Insects with cases, insects with four naked wings, and insects with two, pass through this state.

The third species displays the parts fairly unfolded, very conspicuous and moveable.—Such are the chrysalides of gnats, and insects which, in the first states, pass their life under water.

Lastly, the fourth species consists of those which, in the form of the body, their legs and antennæ, resemble the perfect insect. These nymphæ walk and eat : the only difference between them and perfect insects, is, that they want wings, and are incapable of generation.—The nymphæ of the dragon-fly, the bug, the grasshopper, and the cricket, are of this sort.

Insects, like other animals, were not discriminated by ancient naturalists, otherwise than by the situations in which they inhabited. Before Linnæus, no philosopher had attempted a systematic arrangement of them, in which they might be distinguished by certain characters.—The first classification of insects was formed by that naturalist. After him, M. Geoffroy attempted a more accurate classification of them.—His division of insects into sections and genera, is a master-piece of precision and perspicuity : It is this naturalist's system which we have adopted. M. Fabricius has since attempted a division of insects, by the form of the jaws.

M. Geoffroy divides insects into six sections, according to the number, the structure, or the want of the wings. The first section contains *coleoptera*, or those insects which have their wings covered with cases. Their mouth is formed by two lateral and corneous jaws, and is the second general characteristic of this section. The May-bug displays these two characteristics.

The second section comprehends the *hemiptera*, whose upper wings are either somewhat thick and coloured, or
half

half hard and opaque; but in this section, the wings do not afford so certain and conspicuous a characteristic as the mouth. The mouth is a long, acute trunk, folded down between the legs. To this section belong the wood-bug, and the balm-cricket.

The third section consists of *tetrapterous insects with mealy wings*, whose four wings are coloured by a scaly dust, which have a trunk, sometimes longer, sometimes shorter, frequently spiral; as, for instance, the butterfly. Linnæus calls these insects *lepidoptera*.

The fourth section consists of *tetrapterous insects having naked wings*. Their four wings are membranous: they have hard jaws.—Such is the wasp. Linnæus has divided these insects into two orders: The *neuroptera*, which have no sting on the anus, and have their wings divided by nerves; and the *hymenoptera*, which have a sting at the anus, and have membranous wings, but no very discernible nerves in them.

The fifth section consists of *dipterous insects*, or insects with two wings. Their mouth is generally of a trunk-form; and, at the root of the wing, they have poisers with knobs at the extremity, serving to balance them.

Lastly, in the sixth and last section, are ranked the *aptera*, insects destitute of wings, such as the spider, the louse, &c.

Beside these primary divisions, M. Geoffroy has established some others, to assist the collector of insects.—
(See Table VIII.)

Although several celebrated naturalists have, since M. Geoffroy, turned their attention on the history of insects; and although M. Fabricius has published a new system of the classification of insects, in which the cha-

ra characteristics are taken from the organs with which they receive their food ; yet I have preferred M. Geoffroy's system, which, as it contains fewer genera and species is far from being so complicated and perplexing as that of M. Fabricius.

ARTICLE VIII.

Of Worms. HELMINTHOLOGY.

WORMS are soft animals, very different in form from insects, with which they have been, by many naturalists, confounded, and far from being so perfectly organized. They have, properly speaking, no bones;—the conformation of their members does not resemble that of insects, nor are they liable to pass through different states. Few of them are known to have organs for generation : Most of them have no head, regularly formed ; and they are all distinguished by the want of feet and scales.

The class of worms is the most numerous, and the least known of all the classes of animals. There are few organized bodies, either dead or living, in which worms are not found. Most naturalists have arranged worms and polypi under one class. They might perhaps be better separated ; as they are widely different in respect to their interior structure and habits. Most worms have a heart and blood-vessels ; but no such organs have been observed in polypi.

The

The worms on which our attention is at present engaged, are to be carefully distinguished from the larvæ insects, which have likewise received the name of worms on account of their form. Their head has jaws; their legs are more or less numerous, but generally about six; and these parts afford characteristics by which they may be distinguished.

Worms are very much disposed to motion; most of them are fond of moisture, and seek after it. In some, the form of the head is not very perfect; and they are mostly hermaphrodites. Such as have heads, have upon them two moveable horns, which they can draw inwards, and which are called *tentacula*. It appears, that almost all worms, when mutilated, reproduce the parts which they lose. This shews their organization to be very simple; and in this particular they resemble polypi.

This class of animals may be divided into four sections: The first containing naked worms, the organization of which is best known, and which, in this property nearly resemble other animals. In the second section, we may arrange worms with a testaceous covering,—shell-worms. The organization of these is not so well known as that of the former class; but M. Adanson's researches have shewn their structure to be nearly the same with the structure of naked worms. The third section may comprehend worms having a crustaceous covering. Of these, the organization is less known than that of either of the two preceding sections; nothing but their external form, and the structure of their mouth having been yet examined. The polypi belong to the fourth section. Many naturalists have already employed them-

selves on the systematic divisions of these different sections. In the division in the eighth table, we have followed Lister, Linnæus, Klein, Ellis, Pallas, D'Argenville.—(*See Table VIII.*) Since that period, M. Brugniere who has paid great attention to this part of natural history, and who is intimately acquainted with the structure of worms, has published in the *Encyclopedie Methodique* a system of classification, which we have thought proper to adopt and exhibit.—(*See Table IX.*)

SECTION

SECTION II.

Of the Functions of Animals, from Man to the Polypus.

THE characteristics of living organic bodies, are, as we have already observed several times, the different functions which they perform with their organs. These we have considered in vegetables; and, the order which we have observed, requires us to consider them also in animals.

The department of medicine to which it belongs to examine the functions of animals, is Physiology. This valuable science should not be confined to man; it ought to be extended to all animals: And in this light are we going to take a hasty view of it at present.

The functions of animals may be reduced to the following:

1. Circulation.
2. Secretion.
3. Respiration.
4. Digestion.

5. Nutrition.
6. Generation,
7. Irritability.
8. Sensibility,

These different functions belong to man, quadrupeds, cetaceous animals, birds, oviparous quadrupeds, serpents, fishes, insects. Worms and polypi are not capable of them all ; and the other classes display them in different degrees.

ARTICLE I.

Of Circulation,

CIRCULATION is one of the first functions of animals : it is the function by which life is maintained : when it ceases, the animal immediately dies : the organs employed in it are the heart, the arteries, and the veins.

The heart is a conical muscle, with two cavities in its bottom, which are called *ventricles*. Beside these are situate two smaller bags called *auricles*. Out of the left ventricle, there proceeds a large artery, which is called the *aorta*, and distributes the blood through the whole body. Another artery, equally large, likewise proceeds from the right ventricle : this is called the *pulmonary artery*, because it spreads, in ramifications, through the lungs. The right auricle receives the blood as it re-

turns :

turns from its circulation through the whole body, by the two *venæ cavæ*. This fluid passes from the right auricle into the right ventricle. From the right ventricle, it issues into the lungs, through the pulmonary artery. Through the pulmonary veins, it proceeds into the left auricle: it passes thence into the left ventricle; and from the left ventricle, by the aorta, through the whole body.

This motion, which proceeds in this manner in the human body, forms two sorts of circulation;—circulation through the whole body, and the circulation in the lungs. The latter was known before the former. The general circulation was discovered by Harvey, an English physician.

In quadrupeds, cetaceous animals, and birds, this function is carried on precisely in the same way as in man. In fishes, the heart has only one ventricle; and, in them, the lungs, or gills, do not receive the blood through a particular cavity in the heart. In reptiles, this function is performed in the same way as in fishes. In insects and worms, the heart consists of a series of knots, which contract, one after another: their vessels are very small, and their blood cold and colourless. Polypi have neither a heart nor blood-vessels: In them, this function is carried on in a more imperfect manner than even in vegetables.

ARTICLE II.

Of Secretion.

SECRETION is a function by which there are separated from the blood, in different organs, juices designed for particular purposes, such as the bile in the liver, &c. This function is one of the most general among animals: it takes place through all the classes; but we cannot describe it as it is performed in them all, without running into too tedious a detail of particulars. We shall only observe, therefore, that, in all animals in which a real circulation is carried on, secretion is regulated by the same laws as in the human species; and appears to take place even in most of those animals which have no heart. Beside that analogy which must necessarily subsist between man and such animals as are possessed of the same organs, in respect to the function of which we are now speaking; almost every different class of animals has peculiar secretions which are not observable in the human species:—such are the secretions of musk and civet, among quadrupeds; of the white of the whale, and ambergris, among cetaceous animals; of the oily juice with which birds dress their feathers; of the virulent humour of the viper; of the glutinous fluid of the scales of fishes; of the acid and acrid juices of the buprestes, staphylini, ants, and wasps, among insects; of the viscid mucilage of snails; of the colouring
juices

juices of purple ; and of many others, which come to be taken notice of under the natural history of the different species of animals.

ARTICLE III.

Of Respiration.

RESPIRATION, considered as it takes place in all animals in general, is a function which brings the blood into contact with the fluid in which they live. For this purpose, man and quadrupeds are possessed of an organ called the *lungs*.—It is a collection of hollow vesicles, which are nothing more but ramifications of a membranous and cartilaginous duct, called the *trachea arteria*,—and of the blood-vessels, which, with their ramifications, form a great many areolæ on the surface of the bronchial vesicles. These vesicles and vessels are supported by a loose and spongy cellular texture, which forms the parenchyma of the lungs. The air, when inhaled, distends these vesicles. The oxigene of the atmosphere combines with the carbone disengaged from the blood, and thus forms carbonic acid, which, together with gas azote, is exhaled. A certain quantity of hydrogene is likewise disengaged from the venous blood, which by its union with the oxigene of the atmosphere, forms the water that is exhaled with the air. Another portion of water proceeding directly from the pulmonary transpiration, is dissolved in the air that is expired.

Caloric

Caloric being separated from the vital air, unites with the blood and restores it to the temperature of 93 or 94 degrees. Thus, the use of this function appears to be the formation of the blood, and the production of its temperature; while it serves at the same time, to carry off some superfluous principles with which this is loaded, by the addition of the chyle and the changes which it undergoes in the course of the circulation.

In cetaceous animals, this function is performed in the same manner: Only, as in these animals there is a direct communication between the two auricles, they are capable of remaining for some time without respiration.

In birds, respiration is performed much in the same way as in the above-mentioned animals; but its influence extends much more through the body. Anatomists have discovered, in the belly of birds, spongy vesicular organs, which communicate with their lungs; and the lungs again extend to the bones of the wings,—which are hollow, without marrow,—by a duct which rises from the upper part of the breast, and opens into the upper and inflated part of the os humerus. This noble discovery, which was made by M. Camper, shews, that the air passes from the lungs of birds into the bones of their wings. And this fluid being rarefied by the heat of the body, renders them very light, and contributes greatly to their flying.

The extent of the pulmonary organ likewise accounts for the temperature of the blood being higher in birds than in man, in quadrupeds or in the cetaceous class. The same cause ought likewise to produce particular modifications of the nature of this fluid, upon
which

which depend those differences that are found in their flesh and in all their solids.

Fishes have, instead of lungs, gills or bronchiæ. These organs consist of membranous fringes, disposed on an arcuated bone, and full of blood-vessels. Water enters by the mouth, passes among the fringes, separating them from one another, presses upon, and agitates the blood, and passes out by two lateral apertures behind the head, on which are two moveable ossæous valves, called *opercula*, supported by the bronchial membrane. Duverney imagined that the gills separated the air contained in the water. M. Vicq d'Azir, who has employed himself a good deal on the anatomy of fishes, is of opinion, that, in their gills, water acts the same part which air acts in the lungs of other animals. One thing certain is, that, as these animals do not respire air, or produce from it carbonic acid, their blood is not of the same degree of heat which that elastic fluid communicates to the blood of animals which respire it: Nor does it appear to be of the same nature with the blood in man, quadrupeds, birds.

Insects are destitute of lungs. They have two ducts, or tracheæ extending along the back, with which, on each side, a number of other smaller ducts communicate; and these terminate, one on the outer side of each ring, by small orifices, called *stigmata*. The stigmata rather appear to be designed for the expiration of a particular elastic fluid; for insects do not die immediately in vacuo; but when the stigmata are closed up, they are thrown into convulsions, and die in a few seconds. The organization of worms is still more imperfect. Polypi are not known to respire at all: in this

function, therefore, they are more imperfect than vegetables, in which tracheæ have been found.

ARTICLE IV.

Of Digestion.

DIGESTION is the separation of the nutritious matter contained in food,—and its absorption by certain vessels, called *lacteals*. It takes place in a canal running between the mouth and the anus, which, in the human body, is dilated towards the upper part of the abdomen. The part dilated, is called the *stomach*, or ventricle. The alimentary canal then becomes narrower: It is twisted in different directions, and takes the name of *intestina*. This long tube, consisting of muscles and membranes, is intended to detain the aliments till all the nutritious matter be extracted from them. There are also other glandular organs situated near the stomach, the purpose of which is to prepare fluids for stimulating the stomach and intestines, and to extract the nutritious part of the aliments. These organs are the liver, the spleen, and the pancreas. The bile and the pancreatic juice run into the first intestine called the *duodenum*, and mix with the aliments: Before that mixture takes place, the aliments are dissolved in the stomach by the gastric juice.

The small intestines, through their whole length, are perforated with the orifices of vessels, the business of which is to take up the chyle. These vessels convey

into the lumbar receptacle, and the thoracic duct; and the chylous fluid is thus discharged into the left subclavian vein; where it mixes with the blood.—Such are the mechanism and the phenomena of digestion in the human body.

Quadrupeds differ widely from one another, in the form of their teeth, stomach, and intestines. Some of these animals, as for instance, the philodotus and the root-eater, are without teeth, and eat nothing but soft aliments. Others, such as the tatou and the sloth, have only the *molars*. Some, such as the elephant and the cow, have both the molares and the canine teeth. Usually, most quadrupeds have three sorts of teeth—molares, canine, and incisory. What is most strikingly remarkable in the diversified structure of the teeth, as has been remarked by Aristotle, Galen, &c. is, that there exists, invariably, a relation between the number and position of the teeth, and the form of the stomach. Quadrupeds having incisory teeth in the two jaws, as the horse, the ape, the squirrel, the dog, the cat, &c. have only a membranous ventricle, like that of the human species. Anatomists call these animals *monogastric*. In them, the function of digestion is performed in the same way as in the human body.—Quadrupeds having incisory teeth only in the under jaw, are *polygastric* and ruminating,—such are the camel, the camelopardalis, the buck, the ram, the cow, the stag, and the kid. These quadrupeds are generally bifurcated and horned; they have all four stomachs. The first is called, in the cow, the *paunch*: it is the largest, and is divided into other four bags. It, together with the second, which opens into the paunch by a large orifice,

receives the aliments.—In these organs, herbaceous aliments are dilated, and their air rarefied : these stimulate the nerves, and thus produce an anti-peristaltic motion, which throws them back into the œsophagus and the mouth, where they undergo a new comminution by the dentes molares ; and being reduced into a sort of soft paste, they are again swallowed, and, together with the drink of the animal, conveyed into the third stomach, the *omasus*, through a semi-canal extending between the œsophagus and that ventricle. Lastly, from the omasus they are conveyed into that ventricle, which, in calves, is called the *rennet-bag*, and there thoroughly digested.—The intestines of ruminating animals are also much larger than those of monogastric quadrupeds. The mechanism with which cetaceous animals are provided for this function, is exactly like that of monogastric quadrupeds.

Birds differ from one another in the structure of the stomach : in some, it is membranous,—in others, muscular. Those possessed of the former characteristic, which may be called *hymenogastric*, are carnivorous : All birds of prey belong to this species. Their stomach contains a very powerful juice, capable even of reducing bones to a soft substance, according to Reaumur's experiments ; their bile is likewise very acrid.—The second, which merit the name of *myogastric*, live only upon grain : their stomach consists of a quadrigastric muscle, covered with a hard, thick membrane, suitable for trituration. These birds have likewise a double cæcum.

Fishes have a membranous stomach, of an oblong form, with a good many appendices : their intestines

are

nerally short. They have a liver, but no pancreas.—Reptiles display the same internal structure: the stomach is capable of an amazing distension. Snakes have been often seen to swallow whole animals much larger than themselves.

Birds have a stomach and intestines, regularly organized.

Swammerdam and Perrault affirm, that a particular sort of cricket has four stomachs;—that is, one stomach divided into four bags, as appears when the animal is dissected.—The stomach of worms is very peculiarly formed: they have also small intestines.—The polypus seems to be nothing but stomach; for it digests very fast. The same orifice serves it both for the mouth and anus.

The digestive organs in all animals constantly furnish the materials for dissolving the aliments, and converting them into chyle. This function may be considered as a true chemical solution.

ARTICLE V.

Of Nutrition.

NUTRITION is the consequence of digestion and circulation. As the solids are always suffering a loss by excretions which they carry on, they need to be repaired; and this reparation they receive from the function of nutrition.—In the first period of the life of the animal, they grow larger; and the animal increases in size.

size. The cellular tissue is usually considered as the organ of this function, and the lymph as the humour from which the solids derive that reparation which they need. It appears, however, that each organ is nourished with a matter peculiar to itself, which it separates either from the blood or from the lymph, or from some other fluid. The muscles, for instance, are nourished by a fibrous matter which they separate from the blood: the bones extract from it a calcareous phosphoric salt, and a lymphatic matter; the pure lymph dries into plates in the cellular texture: concrescible oil, deposited in these, produces the fat. Every different part of the body is nourished in a way peculiar to itself: the nutrition of each of these parts is truly an act of secretion. The system of the absorbents seems to contribute powerfully to the exercise of this function. This function is carried on in quadrupeds and cetaceous animals, precisely in the same way as in man: In birds, still in the same way; in fishes much slower,—and they therefore live very long. In general, the slower the nutrition and growth, the longer is the life of the animal.

There is nothing peculiar in the manner in which this function is carried on in insects. They grow only in the form of larvæ; but not when chrysalides or perfect insects. Swammerdam and Malpighy have shewn, that the larva contains the perfect insect, fully formed, under a number of skins;—the caterpillar incloses the butterfly, with its feet and wings folded.

In worms and polypi, nutrition is carried on in the cellular tissue; and in vegetables, likewise, by means of the cellular and vesicular tissues.

ARTICLE VI.

Of Generation.

GENERATION, considered through the whole animal kingdom, is performed in many various ways. In most genera there is a distinction of sexes, and copulation is requisite for the production of the species;—such, for instance, is the law with respect to man, quadrupeds, and cetaceous animals.

The females of quadrupeds have a matrix parted into two cavities, *uterus bicornis*, and a greater number of teats than the female of the human species: they are not subject to the menstrual flux: most of them produce several young at one time, and the period of their gestation is commonly shorter. Several of them have a particular membrane, for receiving the urine of the fetus: it is called *allantoides*.

The manner of generation, in birds, is very different. The males have a very small genital organ, not perforated, and often double. In the females, the vulva is usually situated behind the anus: they have ovaria, but no matrix, and a duct through which the egg is conveyed from the ovaria into the gut: this duct is called the *oviductus*. Physiologists who have examined the phenomena of incubation, have observed some unexpected facts with respect to the egg, both fecundated, and not fecundated. Malpighy and Haller have made

the most important of these discoveries. Haller found the pullet fairly formed in eggs not fecundated.

Copulation does not take place among fishes. The female deposits her eggs on sand, and the male passing over them, impregnates them with his seminal liquor which is no doubt necessary for their fecundation. After a certain period, these eggs burst, and emit the young fishes.

The males of various species of oviparous quadrupeds have a double or forked organ for generation. Of serpents, the viper is the only viviparous species.

Insects alone display all the varieties with respect to this function that are observable among other animals: some species exhibit the distinction of sexes among individuals,—this, indeed, is the case with the greatest number: in other species, reproduction takes place either with or without copulation,—as in the vine-fretter: an insect of this species, inclosed by itself in a glass, produces a great number of young. M. Bonnet has fully established the truth of this fact, by a series of experiments prosecuted with the utmost care. The genital organ of male insects is concealed in the belly. When the extremity of that part of the insect's body is gently pressed, the organ appears. It is usually accommodated with two small arms for holding the female. The situation of this organ is very much varied: it is sometimes on the upper part of the belly, near the breast,—as in the female of the dragon-fly, *libellula*; at other times, it is situated at the extremity of the antenna,—as in the male spider. Insects multiply prodigiously, and are almost all oviparous, excepting the wood-lice,

Worms

Worms are androgynous : every individual possesses the characteristics of both sexes : and copulation is double,—as may be observed of the earth worm and the snail.

M. Adanson adds, that bivalvular shell worms are destitute of organs of generation, and reproduce the species without copulation. These worms are viviparous.—Univalvular shell worms are oviparous: the young, whether they issue from an egg, or immediately from the belly of the mother, have the shell ready-formed from their birth.

Polypi are the most singular animals with respect to generation. They produce by shooting off slips.—When a polypus attains its full growth, it shoots out, as it were, a small branch, which is separated from it, and fixes on any contiguous body ; where it continues to grow till it have nearly gained its full size. Polypi, in short, are produced from one another, much in the same way as branches spread from the trunks of trees.

We know only the more apparent phenomena of generation.—All the systems which have been formed to explain that mysterious operation of nature, are attended with insuperable difficulties. Accounts of them may be found in Haller's *Physiology*, Maupertuis's *Venus Physique*, and Buffon's *Natural History*.—M. Bonnet, in his *Reflections on organized Bodies*, has said more on this subject than almost any other person.—Buffon's system is ingenious, and deserves to be read.

Through the whole animal kingdom, eggs seem to pre-exist in the female, and the fecundating liquor of the male only communicates the first movement to the heart. The fecundating power of this fluid is such, that

when diluted with a large quantity of water, it still retains this property; as is observable in the frog.

ARTICLE VII.

Of Irritability.

IRRITABILITY is a property of certain organs, called *muscles*, by virtue of which they contract when acted upon by the contact of any stimulus.—M. Haller has given a very good account of the doctrine of irritability.—The muscles of man, quadrupeds, cetaceous animals, and birds, resemble each other. They are all equally red, and consist of fibres united in bundles of different forms, covered with silver-coloured membranes called *aponeuroses*, and terminating in flat or round cords called *tendons*.

The muscles of fishes are white, and much more irritable than such as are red.—The muscles of oviparous quadrupeds and serpents are still more irritable; and in these animals the irritability remains long after the death of the animal. This last property appears to be common to all cold-blooded animals; but those whose blood is hot, seem to lose the irritability of their muscles as it becomes cold.

The muscles of insects are within the bones, which are hollow and of a corneous nature. This structure is very discernible in the thigh-bone of the great green grasshopper, and also in the crab.

The muscles of worms are very pale and irritable : they are even very strong,—especially in those worms which have a ponderous shell to move.

Polypi are very irritable : they contract into a round point ; they move their arms with amazing agility, and fold them very readily. Their structure, however, does not appear to be muscular.

It is their irritability which renders animals capable of moving from one place to another, and performing such motions as are necessary, that they may remove hurtful things to a distance, and procure what they need. The history of these motions is therefore referable to the history of this function. Standing and walking, leaping, flying, the pace of reptiles, and swimming, are a combination of actions which depend on the muscular contractions of animals. Were we to enter into a minute detail of them, it would be necessary to consider, in the human species, with respect to standing,—the muscles which serve to extend the thigh ; with respect to leaping,—the extremities, the form of the body, the length and acuteness of the countenance, and the lateral compression of the thorax, in quadrupeds ; with respect to flying,—the structure of the feathers, the breast-bone, the pectoral muscles, the bill, the tail, and the interior texture of the bones in birds. It would be no less necessary to consider the muscular rings, and the scales or tubercles which reptiles have instead of feet ; in fishes, the form of the body, the structure of the fins, the structure of the air-bladder, and its communication with the stomach ; in insects, the structure, the number, and the position of the legs, the appendices of the tarsi, the form, the position, and the nature of the wings, and of

those organs which nature has given them to balance themselves in the air, &c. But it is enough for us at present to have pointed out the importance of such researches, and that they are highly worthy of the attention of the physiologist.

Lastly, there is another consideration which does not appear to me to have been hitherto properly attended to. Muscles may be considered as organs of secretion, intended by nature for the separation of the fibrous and irritable matter of which we have elsewhere spoken. The disorders to which this sort of secretion is liable, should be carefully observed by physicians. We have already had occasion to treat of this in our account of the blood.

ARTICLE VIII.

Of Sensibility.

SENSIBILITY is a function, by means of which animals are susceptible of sensations of pleasure and pain, according to the respective natures of bodies in contact with their organs. Sensations depend on the brain, on the medulla oblongata, on the the medulla spinalis, and numerous nerves which are diffused from these parts, all over the body: without these organs, there could be no sensibility. In order the better to explain the nature of this function, we may divide into three regions those organs which appear to form only one whole; which

which physiologists have called the *sensible man*. These three are, the brain, comprehending the cerebellum, and the spinal marrow,—the nerves diffused from these parts over the body,—and the sensitive expansion, or dilated extremity of the nerves. This extremity or expansion exhibits a great diversity of forms in the different organs: it is sometimes membranous and reticular,—as in the stomach and the intestines; sometimes soft and pulpy,—as at the bottom of the eye, and within the labyrinth of the ear. Under the skin, on the tongue, on the top of the glans, &c. it takes the form of papillæ; and in other places,—as on the nasal membrane of Schneider, it is spread out in long filaments, soft and flat.

The brain of the human species is larger, and better organized than that of any other animal: it is the seat of thought. In quadrupeds, it is much smaller; but their nerves are more sensible; and their senses, particularly the sense of smelling, more acute,—the organ of this sense being very much dilated, and, as it were, multiplied, by the number of the ethmoidal plates. The skin being thick, and covered with hair, is, on that account, not possessed of great sensibility. The taste of these animals is very delicate.

The brain of cetaceous animals is exceedingly small, in comparison with the size of the body: it is encompassed by a thick, oily fluid: their senses are obtuse.

The brain of birds is not of the same structure, nor has it the same folds, convexities, and concavities with that of the human species and quadrupeds. The beautiful structure of the eyes of those animals; their thick and cartilaginous sclerotica; the *membrana nictitans*, or interior eye-lid, moved by particular muscles; the bulk

of the crystalline and vitreous substances; the bag of black matter, at the extremity of the optic nerve; the brilliant crust which coats the choroides;—all these together, display a very complicated organization, and shew, that nature has taken extraordinary pains to render the powers of vision of these animals keen and piercing; and thus enable them to distinguish their prey at a distance, and avoid the dangers to which they are exposed by the rapidity of their motion in flying: In a word, to favour the agility and activity of motion, which seem to be the peculiar prerogatives of these animals. Their hearing is not so perfect as their sight. They do not appear very capable of distinguishing either the taste or the smell of aliments. The situation of the nostrils, and the hard membrane which covers the bill, account for these phenomena.

Reptiles have but very little sensibility. Their brain is very small: there are no ganglions on their nerves: their senses, in general, appear to possess but very little activity. Yet Messrs Klein, Geoffroy, and Vicq d'Azyr, have observed the internal structure of both the eye and ear of these animals to be extremely beautiful and regular.

The brain, in fishes, is very small; and the cranium is filled with a mass of oily matter. Their senses, especially those of sight and hearing, are very acute. The conformation of the organ of hearing, in fishes, is very regular,—as has been observed by Messrs Klein, Geoffroy, Camper, and Vicq d'Azyr.—Those naturalists who took fishes to be deaf, were mistaken.

Insects have no brain; but they have a medulla oblongata, of a cylindrical form, and full of knots, which

uns through the whole length of the body. Nervous filaments spread out from this medulla, and accompany the distribution of the tracheæ.—Of the organs of sensation, none but the eyes are known in insects. Swammerdam describes an optic nerve, under the cornea of the eyes of insects that are reticulated, which is there distributed into filaments equal in number to the facets of this membrane. We know not whether they have an organ of hearing.

The organs of sensation which have been observed in worms, are scarcely more numerous. Swammerdam found in the snail, a brain with two lobes and moveable,—eyes, sometimes at the base, sometimes on the top of the tentacula,—and an optic nerve, capable of contraction as well as these horns. M. Adanson tells us, that the eyes are sometimes wanting in worms, or at least covered with opaque skin.

As to polypi; they have no organs of sensation, and yet they seem to have a sort of predilection for light.

Man, therefore, possesses the function of sensibility in a much more eminent degree than any other animal. This is what peculiarly distinguishes him, and entitles him to be ranked at the head of the animal creation.—The legislator, the philosopher, and the physician should be intimately acquainted with every particular relative to this function.

S U P P L E M E N T
TO THE
M I N E R A L K I N G D O M.

*Of the Nature of Mineral Waters, and the Methods of
analysing them.*

AFTER having considered all the bodies belonging to the mineral kingdom, and examined their physical properties, it seems proper to introduce, in this place, the history of mineral waters; for, as these fluids generally hold, in solution, terrene, saline, and metallic matters, either together or separately, it would have been impossible to make the reader understand their nature and composition, without making him previously acquainted with the nature of the principles by which they are mineralized. Another advantage arising from our introducing, in this place, the account of mineral waters, is, that it may here serve as a sort of recapitulation of what has been said of minerals in general; as their principles must be taken notice of, in considering the manner of analysing them.

§ I. *Definition and History of Mineral Waters.*

WATERS holding minerals in solution, are called *mineral waters*. But as all water, in a natural state, is impregnated, either more or less, with some mineral substances, the name, *mineral waters*, should be confined to such waters as are sufficiently impregnated with mineral matters, to produce some sensible effects on the animal œconomy, and either to cure or prevent some of the diseases to which the human body is liable *. On this account, these waters might be, with much more propriety, called *medicinal waters*,—were not the name by which they are commonly known too firmly established by long use.

The first knowledge which mankind acquired of mineral waters, was, like other branches of human knowledge, obtained by accident. Their having accidentally produced beneficial effects on the health of people who made use of them, was, no doubt, the first cause which occasioned them to be distinguished from common waters. The philosophers who turned their attention upon them, considered only their sensible qualities,—colour, gravity or lightness, taste and smell. Pliny took notice of a great many different sorts of water, distinguished either by conspicuous physical properties,

* It is to be observed, that though waters contain no mineral principles which can be discovered by analysis, they may yet produce sensible effects on the animal œconomy. For this purpose, they need only to be very light and active, and of an hotter temperature than common water. Such are the waters of Plombieres and Luxeuil, which differ only in temperature from common water.

perties, or by the useful effects which they were capable of producing. But it was only in the seventeenth century that people began to think of examining the principles dissolved in these waters, by subjecting them to chemical processes. Among the first who attended to this object, was Boyle, who, in the account of his ingenious experiments on colours, published at Oxford in the year 1663, mentions various re-agents, which, when poured into water, shew, by the alterations which their colours suffer, what substances are dissolved in the water.—The Academy of Sciences, ever since their institution, have been highly sensible of the importance of the analysis of waters; and in the year 1667, Dulong engaged in an examination of the different mineral waters in France. Among the earlier Memoirs of that Society, are the experiments of this chemist on those waters. Towards the end of the seventeenth century, Boyle engaged, in a more particular manner, in examining mineral waters; and in the year 1685, he published a work on the subject. Boulduc, in the year 1729, published an account of a process for analysing mineral waters, greatly preferable to any of those which were commonly in use before that period: He directed to evaporate the water under examination; and, during the progress of the evaporation, to separate, by a filter, the substances deposited.

Various celebrated chemists have since been successful in researches into the nature of mineral waters. None of them has failed to make important discoveries concerning the different principles contained in those fluids. Thus Boulduc discovered in them *natrum*, the nature of which he ascertained,—Le Roy of Montpel-

lier,

lier, calcareous muriate,—Margraf, magnesian muriate, —Dr Priestley, carbonic acid.—Messrs Monnet and Bergman, sulphurated hydrogenous, or *hepatic*, gas. The two last of these chemists, beside enriching this department of chemical knowledge with new discoveries, have published complete treatises on the processes for the analysis of mineral waters, and have introduced into it, more accuracy and precision, by which it is greatly improved. There are, besides, many analyses of particular mineral waters, which have been made by very ingenious chemists, and throw much light on this part of experimental knowledge, which is, with good reason, considered as the most difficult branch of chemistry. Our limits do not here permit us to enter into a detail of all the information concerning mineral waters to be found in the different works on the subject: But we shall take care to mention, occasionally the authors from whom we derive the information which we communicate.

§ II. *Of the Principles contained in Mineral Waters.*

It is only within these few years, that all the principles liable to be dissolved in mineral waters have been certainly known. The reason of this may be naturally understood to be, that we have only of late acquired the chemical knowledge necessary to enable us to determine the nature of those matters, and that their existence could not be ascertained till the means proper for that purpose were adopted. Another reason which has retarded the progress of science in this department,

is,

is, that mineral matters are never found dissolved in waters but in very small quantities, and a number of them always mixed together; and these circumstances conceal from observation the properties by which they are respectively distinguished. Notwithstanding these and other unfavourable circumstances, the numerous researches of the chemists above mentioned, and of others to be hereafter taken notice of, have shewn, that several mineral substances are very generally found in water; that some others are but seldom found naturally dissolved in that fluid; and lastly, that various mineral substances are never dissolved in it at all. Let us, however, review the different classes of these substances, in the same order in which we have already traced their history.

Siliceous earth is sometimes suspended in waters; and being then very much attenuated, it is not liable to be precipitated; but the proportion in which it is found is always exceedingly small. The carbonated alkalies and chalk, perhaps contribute to render siliceous earth soluble.

Aluminous earth is likewise met with in waters. The extraordinary fineness of that earth, which causes it to be diffused all through water, makes it also destroy the transparency of the fluid. Argillaceous waters are therefore foul and whitish, and of a pearl or opaline colour: they likewise feel greasy, and have received the name of *saponaceous*. The carbonic acid would seem to favour the suspension and solution of alumine in water.

Barytes, magnesia, and lime, are never pure in water, but always combined with acids.

Neither

Neither are the fixed alkalis ever found in water, in a state of purity, but often in neutral salts.

The same is the case with ammoniac and most of the acids. Yet carbonic acid is often found in waters, in a state of freedom, and possessed of all its properties: It even characterizes a peculiar class of mineral waters, known by the name of *gaseous, spiritous, or acidulated waters.*

There are none of the neutral salts, with bases of fixed alkalis often found in solution in mineral waters, except sulphate of soda or *Glauber-salt*, muriate of soda, muriate of potash, and carbonate of soda. Nitrate and carbonate of potash are found but seldom.

Sulphate of lime, calcareous muriate, chalk, sulphate of magnesia or *Epsom salt*, muriate of magnesia, and carbonate of magnesia, are more commonly met with in water than any of the other terrene salts. As to nitrate of lime and nitrate of magnesia, which some chemists tell us they have found in mineral waters; these salts are scarce ever found but in salt waters, not in mineral waters properly so called.

Aluminous neutral salts, as well as those which have a base of barytes, are almost never found in solution in waters. Alum or aluminous sulphate appears to exist in some waters*.

Pure hydrogenous gas has not been hitherto found in mineral waters.

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Neither

* We speak not, here, of the opinion of Givré, and other chemists, who thought alum to be one of the principles the most prevalent in mineral waters: but of the accurate analyses by which M. Mitouart discovered the existence of alum in the waters of *Dominique de Vals*, —and M. Opoix, in the waters of *Provins*.

Neither has pure sulphur been found in these fluids: sometimes, though *but* seldom, they contain a small quantity of it in the state of sulphure of soda. But it is most frequently sulphurated hydrogenous gas which mineralizes sulphureous mineral waters.

Lastly, Iron is more commonly found in mineral waters than any other of the metals: It is found in them in two different states,—either combined with carbonic acid, or in union with sulphuric acid. Some chemists have been of opinion, that it may also exist in waters in a pure metallic state, without any intermediate acid. But as this metal is scarce ever found in nature, unless in the state of oxide, and in combination with carbonic or sulphuric acid,—this opinion could never have been adopted, if its authors had not been ignorant of the existence of the former of these two acids, and at a loss to conceive how iron could be dissolved in water, without the help of the sulphuric acid. Bergman asserts, that both it and manganese are found in some waters in union with muriatic acid.

Oxid of arsenic, sulphate of copper, and sulphate of zinc, which are found in many waters, communicate to them noxious qualities; and the only reason for being at pains to detect any of these salts in water, is, in order that the water may be carefully abstained from.

Several authors have admitted the existence of bitumen in mineral waters; but scarce any chemist now agrees to this. It was the bitter taste of these waters which made them be suspected to contain this oleaginous body. But bitumen is now known not to have any such taste; and the waters are known to derive it from calcareous muriate.

It is easy to imagine, that as water runs through the interior parts of the globe, especially in mountains, it must naturally be impregnated with the different substances here enumerated. The different strata of earth through which waters run, and the extent of those strata, likewise serve to account for their being more or less impregnated with mineral principles, and for the diversity of the principles found at different times in the same waters,—especially if to these considerations we add, that the various alterations to which our globe is liable, particularly at the surface, and in its more elevated parts, must often cause those fluids to change the direction of their course.

§ III. *Different Classes of Mineral Waters.*

FROM what has been here said concerning the different matters usually contained in mineral waters, the Reader may perceive, that the classes of mineral waters may be equal in number to the terrene, saline, and metallic matters liable to be dissolved in the fluid; and of consequence very numerous. But it is to be observed, that no one of the substances which we have enumerated is ever found in waters alone, and unaccompanied with any of the others; and that waters often contain minerals, to the number of three, four, five, or even more. This is one difficulty unfavourable to a systematic division of mineral waters, according to the principles which they contain. Yet by considering principally the matter which exists in the greatest abundance in any mineral water, and whose properties are the most eminent, we may form distinctions which, though not

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exceedingly

exceedingly accurate, will yet serve to indicate the nature of any of these fluids, and enable us to judge of its virtues. In this way have mineral waters been distinguished by the different chemists who have engaged in experiments upon them. M. Monnet divides them into three classes,—alkaline, sulphureous, and feruginous. From late discoveries, it appears necessary to enlarge the number of the classes. M. Duchanoy, who has published a valuable work upon mineral waters, distinguishes them into ten classes,—gaseous, alkaline, earthy, ferruginous, hot without any mineral, gaseous hot waters, saponaceous, sulphureous, bituminous, and saline waters. This author may indeed be blamed for having extended the classes of mineral waters to too great a number, as we are unacquainted with either pure gaseous, or pure bituminous waters; yet his division is undeniably the most complete, and conveys the most just ideas of the nature of the various mineral waters; nor could he have adopted any other more suitable to his subject.

To explain briefly the order in which mineral waters may be arranged according to their principles, and complete what we have already said on this subject, we shall here propose another division of those waters, less extensive, but more regularly systematic than M. Duchanoy's: in which it is to be observed, that we do not include thermal waters, which are merely hot without an addition of any mineral, as the best chemists consider these as nothing else but hot water: neither do we choose to include bituminous waters, as there are none, really such, known to exist in nature.

To us it appears, that all waters may be arranged in
four

four classes,—acidulated waters, salt waters, sulphureous waters, and ferruginous waters.

CLASS I. *Acidulated Waters.*

GAZEous Waters, which may be, with much more propriety, called *acidulated*, are waters in which carbonic acid predominates. They are known by the poignancy of their taste, and the facility with which they boil, and give out bubbles, even by shaking. They redden tincture of turnsole, and precipitate lime-water and alkaline sulphures. We know of no waters containing this acid, in a pure, insulated state; and waters of this class may therefore be subdivided into several orders, according to the other principles contained in them, or the several modifications which they display. They all appear to contain either more or less of alkali and calcareous earth; but their different degrees of temperature enable us to divide them very naturally into two orders. The first of these orders may comprehend cold acidulated and alkaline waters, such as those of Seltz, Saint Myon, Bard, Langeac, Chateldon, Vals, &c. Under the second, we may arrange hot or thermal acidulated and alkaline waters,—such as those of Mont d'Or, Vichy, Chatelguyon, &c.

CLASS II. *Saline or Salt Waters.*

WE give the name of *saline* or *salt waters* to waters holding in solution a quantity of neutral salts, sufficiently considerable to act in a very discernible manner, most commonly purgative, on the animal œconomy. It is

again, those of Saint-Amant, Aix-la-Chapelle, and Montmorency, belong to the second. Most of these are hot-bath waters: The water of Enghien-les-Bains, or Montmorency, is cold.

CLASS IV. *Ferruginous Waters.*

As iron is the most plentiful, and the most liable to alteration of all metals, it is by no means surprising that water should be easily impregnated with it. Accordingly, ferruginous waters are the most copious, and the most common mineral waters. Modern chemistry has thrown much light on this class of waters. They were formerly thought to be all sulphuric. M. Monnet affirms, that scarce any of them contain sulphate of iron; and he is of opinion, that the metal is dissolved in them without the intervention of any acid.

It is now known, that iron, not in the state of sulphate of iron, is dissolved by means of carbonic acid; and thus forms the salt which we have denominated *carbonate of iron*. Messrs Lane, Rouelle, Bergman, and various other chemists, have established this truth beyond a doubt.—The different proportions of carbonic acid, and the state of iron in waters which owe their virtues to this metal, induce us to distinguish this fourth class into three orders.

The *first* comprehends acidulated martial waters, in which the iron is held in solution by carbonic acid, and the acid exists in so large a proportion, as to render them poignant, and somewhat sour to the taste. The waters of Bussang, Spa, Pyrmont, Pougues, and La Dominique de Vals are of this order.

The *second* order contains simple martial waters, hav-

ing the iron dissolved by carbonic acid, without any excess of the acid. Those of Forges, Aumale, Condé, and most other ferruginous waters belong to this order.— This distinction among ferruginous waters was made by M. Duchanoy.

But we may add a *third* order, after M. Monnet.— This order comprehends waters containing sulphate of iron. Such waters are extremely rare; but there are some such. M. Monnet ranks the waters of Passy in this order. M. Opoix admits the existence of sulphate of iron, even in a very considerable proportion, in the waters of Provins. M. Fourcy, indeed, denies its existence in them, and imagines the iron in those waters to be dissolved by carbonic acid: But we cannot yet decide in this case; for the results of the two chemists are directly opposite to each other, and a new examination of the waters is therefore requisite. We may add, that iron is never found alone in waters: it is always mixed with chalk, sulphate of lime, different muriatic salts, &c. But as the metal is the principal basis of the properties of such waters they are, therefore, according to the principles which we have laid down, to be called *ferruginous waters**.

As to saponaceous waters, which are admitted by M. Duchanoy, before we can allow their existence, we must wait till chemical and medical experiments determine the cause of their saponaceous properties, which that
physician

* In this classical enumeration of waters, we avoid speaking of such as contain arsenic and copper; they being considered as poisonous. We likewise pass over in silence, waters containing ammoniacal salts and extractive substances, produced by the putrefaction of organic matters, over which the water has stagnated. Waters of these kinds are not medicinal.—F.

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physician thinks owing to alumine, and the effects which those properties enable them to produce on the animal economy, as medicines.

From these particulars it appears, that all mineral or medicinal waters are comprehended in nine orders.

Cold acidulated waters.

Hot acidulated waters.

Sulphuric salt waters.

Muriatic salt waters.

Simple sulphureous waters.

Sulphurated gaseous waters.

Simple ferruginous waters.

Ferruginous and acidulated waters.

Sulphuric ferruginous waters.

§ IV. *Examination of Mineral Waters, as distinguished by Physical Properties.*

AFTER mentioning what different matters are found in waters, and exhibiting a slight sketch of the manner in which they may be divided into classes and orders, according to their principles; we must next give an account of the processes for analysing them, and distinguishing, with all possible accuracy, what substances they contain. This analysis has been thought the most difficult part of chemistry; and with good reason; as it requires both a familiar knowledge of all the chemical phenomena, and skill in conducting chemical operations. In order to ascertain, with accuracy, the nature of water, we must, 1. observe the situation of the spring from which it proceeds, and describe faithfully the neighbouring grounds, and strata of minerals; and, in order to discover

to discover the nature of those strata, it will be necessary to dig trenches, and examine, by a narrow inspection, with what substances the water is liable to be impregnated. 2. The physical properties of the water, its taste, smell, colour, transparency, weight, and temperature, are next to be examined. Two thermometers, graduated so as to rise and fall as nearly together as possible, with an areometer; are requisite for this purpose. These preliminary experiments should also be made in different seasons, at different hours of the day, and when the atmosphere is in different states. Long continued dryness, or copious rains have a powerful influence on waters. These first observations generally shew to what particular class the water under examination is to be referred, and of consequence, regulate the remaining part of the analysis. 3. Sediments in the bottom of vessels containing water, substances swimming on its surface, and sublimated matters exhaled from it, are important objects of observation to be neglected. After this preliminary examination, we may proceed to analysis properly so called, which is performed in three ways,—by reagents, by distillation, and by evaporation.

V. Examination of Mineral Waters by Reagents.

THE name of *reagents* is given to substances which mixed with waters, in order to discover, by the phenomena which they produce, the nature of the matters which those waters hold in solution.

The most exact chemists have always considered the use of reagents as a very uncertain means of discovering the principles of mineral waters. Their reasons for
thinking

thinking so, are, that the action of reagents never indicates, in an exact manner, the nature of the matters held in solution by those waters; and that the causes of the changes produced in mineral waters by the mixture of reagents, are frequently unknown: in truth, the saline matters employed for this purpose, are capable of producing many changes, concerning the nature of which it is very hard to say any thing decisive. Most of those, therefore, who have engaged in researches of this nature, have put but little trust in reagents: they have thought evaporation a much surer way of discovering the nature and the quantity of the principles of mineral waters. And in the best works on the analysis of these fluids it is laid down as a principle, that reagents are to be used only as auxiliaries, which, at the utmost, only afford grounds for plausible conjectures concerning the principles by which the waters are mineralized. On this account, only a certain number of reagents are now admitted; and the list of those employed by the earlier chemists is greatly reduced.

But it cannot at present be doubted, that, however gentle the heat necessary for the evaporation of waters, yet it must produce sensible alterations on their principles and change their nature so far as to make their residue, when examined by chemical processes, afford compounds different from those which were dissolved in the water. The loss of the gaseous matters, which are often among the most active principles of mineral waters, occasions a singular change of their nature; and, besides causing several bodies to be precipitated which owe their solubility to the presence of those volatile substances, produces a reaction among the other fixed matters
which

which alters their properties. The phenomena of the double decompositions effected by heat, on compounds which suffer no alteration in cold water, cannot be properly estimated, without a long series of experiments; and our ideas concerning them, are therefore as yet but very imperfect. Without entering into a tedious detail of particulars, it is enough, that the truth of these facts is allowed by all chemists, to convince us that we cannot trust solely to evaporation. But is there any means of determining the nature of the substances dissolved in waters, without having recourse to the action of heat? Does the more accurate knowledge of chemical phenomena, which we have derived from the numerous experiments of modern chemists, afford any process by which the errors into which we are liable to be led by the results of evaporation, may be corrected? The particulars which I am about to mention, which are extracted from a Memoir read by me before the Royal Society of Medicine, will shew that very pure reagents, employed in a certain way, may be rendered much more serviceable in the analysis of mineral waters than has been hitherto thought.

Among the numerous reagents, the use of which has been proposed in the analysis of mineral waters, those from which most advantage may be derived, are, tincture of turnsole, syrup of violets, lime-water, pure or caustic potash, caustic ammoniac, concentrated sulphuric acid, nitrous acid, prussiate of lime, gallic alcohol, or *spiritous tincture of nut galls*; nitric solutions of mercury and silver; paper coloured by the aqueous tincture of fernambouc, which is rendered blue by alkalis; the aqueous tincture of *terra merita*, to which

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the same salts communicate a red-brown colour; oxalic acid, for detecting the presence of even the smallest possible quantity of lime; and barytic muriate, for ascertaining the presence of even the most trifling quantities of sulphuric acid.

The effects and the use of these principal reagents have been explained by all chemists; but the particular state in which they are to be used has not been sufficiently attended to. Before employing them, we should carefully make ourselves acquainted with their nature, that we may not incur mistakes respecting their effects. Bergman has enlarged, at great length, on the effects which they are capable of producing. This celebrated chemist tells us, that paper coloured by tincture of turnsole, takes still a deeper colour when exposed to the action of alkalis, but suffers no alteration of colour from carbonic acid. As it is principally with a view to ascertain the presence of this acid, that this colouring matter is used, he advises to employ its tincture only in water, and to dilute it to such a degree as to make it take a blue colour. He absolutely rejects the use of syrup of violets, because it is liable to ferment, and is scarce ever to be obtained genuine in Sweden. M. de Morveau adds, in a note, that it is easy to distinguish syrup coloured by turnsole, by means of corrosive sublimate, which communicates to it a red colour, but gives to syrup of violets a green colour.

Lime-water is one of the most useful reagents in the analysis of mineral waters, although few chemists have made express mention of it in their works. This fluid decomposes metallic salts, especially sulphate of iron, the metallic oxide of which it precipitates. It separates a
luminous

luminous earth or magnesia, from the sulphuric, or the muriatic acids, with which those substances are often combined in waters. It also indicates, by precipitation, the presence of carbonic acid. M. Gioanetti, a physician of Turin, has ingeniously contrived to ascertain, by lime-water, the proportion of carbonic acid contained in the waters of St Vincent. This chemist, after observing that the bulk of this acid, from which people have been in use to judge of its quantity, varies with the temperature of the atmosphere, mixed nine parts of lime-water with two of the water of St Vincent's. He weighed carefully the calcareous earth formed by the transition of the carbonic acid from the mineral water into the lime; and found, by Jacquin's scale, which shews thirteen ounces of this acid to be contained in thirty two ounces of chalk,—that the water of St Vincent's contains somewhat more than fifteen grains. But as lime-water is capable of detaching carbonic acid from fixed alkali, as well as of seizing that which is in a disengaged state; M. Gioanetti, in order to ascertain exactly the quantity of the latter, performed the same operation with water deprived of its disengaged acid by ebullition. This process may therefore be employed to determine, in an easy and accurate manner, the weight of the disengaged carbonic acid contained in any gaseous mineral water.

One of the chief reasons which have induced chemists to pay little regard to the phenomena produced by reagents in the analysis of mineral waters, is, that they shew the existence of various substances in those waters; and it is then very difficult to discern exactly what effect they produce. This observation chiefly regards pot-

ash

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ash considered as a reagent ; for this alkali decomposes all salts formed by the union of acids with aluminous earth, magnesia, lime, and metallic matters. When an alkali precipitates a mineral water, it cannot be determined, merely by inspecting the precipitate, what is the particular nature of the earthy salt decomposed in the experiment. Its effects are still more uncertain, when potash saturated with carbonic acid is employed, as is commonly done ; for the acid combined with the alkali, then increases the confusion. For this reason, I recommend the use of very pure caustic potash ; which has, besides, another advantage over effervescent alkali, as it indicates the presence of chalk, which may be dissolved in gaseous water by means of an excess of carbonic acid. As it seizes the acid, the chalk becomes insoluble in the water, and is precipitated. I made myself certain of this fact, by pouring soap-maker's lixivium, recently prepared, into factitious gaseous water holding chalk in solution. The chalk was by degrees precipitated, as the caustic fixed alkali seized the carbonic acid by which it had been held in solution. On evaporating this water to dryness, after filtration, I obtained carbonate of soda, which effervesced in a very discernible manner with acids. Caustic fixed alkali will also produce a precipitate in mineral waters, even when they contain no earthy salts. If they contain only an alkaline neutral salt, less soluble in its nature than the caustic alkali, the latter will then precipitate it as it unites with the water, nearly in the same way as alcohol does. M. Giovanetti observed this phenomenon in the waters of St Vincent : it is, besides, easy to exhibit it, by pouring caustic alkali into a solution of sulphate of potash

potash or muriate of soda : either of these salts is soon precipitated.

Cautic ammoniac is, in general, less liable to occasion mistakes, when mixed with mineral waters ; for it decomposes only salts having a base of aluminous earth or magnesia, but does not precipitate calcareous salts. But there are two important observations to be made on this head. The first is, that the ammoniac must be very caustic, not containing a single particle of carbonic acid ; if not in this pure state, it decomposes salts with a base of lime, by double affinity. The second is, that this mixture must not be left exposed to the air, when we desire to know in what manner it acts some hours after its formation ; for, as has been very properly observed by M. Gioanetti, this salt, in a short time, attracts carbonic acid from the atmosphere, and thus becomes capable of decomposing calcareous salts. To remove every doubt concerning so important a matter, I made three decisive experiments.—After dissolving in distilled water, a few grains of sulphate of lime, prepared from transparent calcareous spar, with very pure sulphuric acid, (a precaution indispensibly requisite,—as Spanish white, or chalk, contains both magnesia and river water), I separated the solution into two parts. Into the first, I poured a few drops of ammoniac very recently prepared and very caustic. I put this mixture into a close-stopped phial. After eight-and-forty hours, it was clear and transparent, without any sediment : No decomposition had, therefore, taken place. The second portion was treated in the same way, with ammoniac, but put into a vessel admitting air. At the end of a few hours, there was formed on the upper part

of it, a cloud, which became, by degrees, thicker, and was at last precipitated. The precipitate afforded a lively effervescence with sulphuric acid, and thereby formed sulphate of lime. The carbonic acid contained in this precipitate must have been supplied by the ammoniac, by which it had been attracted from the atmosphere. This combination of carbonic acid and ammoniac forms ammoniacal carbonate, capable of decomposing calcareous salts by a double affinity,—as has been shewn by Dr Black, M. Jacquin, and several other chemists,—and as any person may see, on pouring a solution of ammoniacal carbonate into a solution of sulphate of lime, which caustic ammoniac does not render turbid. Lastly, to make myself still more certain of the phenomena of this second experiment, I took the first portion of the water united with the ammoniac ; which, having been preserved in a close vessel, had lost nothing of its transparency. I turned the mouth of the phial containing it upon a funnel belonging to a very small pneumato-chemical apparatus, and passed into this mixture, by means of a syphon, the carbonic acid gas disengaged from the effervescent fixed alkali by the sulphuric acid. As this acid passed in bubbles through the mixture, it becomes turbid, in the same way as lime-water on the same occasion. On filtering it, chalk was found on the filter ; and ammoniacal sulphate was obtained by evaporation. The gaseous water, or liquid carbonic acid, produced the same decomposition in another mixture of sulphate of lime and caustic ammoniac. This decisive experiment fully proves, that it is only by double affinity, and by the addition of carbonic acid, that ammoniac decomposes sulphate of lime. From
this

this it appears, that when we need to preserve a mixture of mineral water with ammoniac, for a few hours, (which is at times necessary, as there are some earthy salts which it decomposes but very slowly), this experiment must be performed in a perfectly close vessel, lest access of air occasion a deceitful result. This precaution is, in general, highly necessary in the use of all reagents : Bergman and M. Gioanetti have also pointed out the necessity of attending to it. I shall here add an observation concerning the use of ammoniac. As it is not easy to obtain ammoniac absolutely caustic, and as it is indispensibly necessary to have it such in analysing mineral waters ; a simple process may be used, of which I have often found the advantage. Pour a little ammoniac into a retort, having its extremity immersed in the mineral water : heat the retort gently ; the ammoniac gas will then be disengaged, and will pass, in an highly caustic state, into the water. If it produce a precipitate, the mineral water must certainly contain either aluminous or magnesian salts, or sulphate of iron : the colour of the precipitate will show the particular nature of the salt. This precipitate most frequently consists of the chalk which was dissolved in the water, by means of carbonic acid. The ammoniac absorbs that acid, and the chalk is then deposited. It is hard to say, from the properties of the earthy precipitate, formed in mineral water by caustic ammoniac, to which of the two bases it is to be referred, and whether the neutral salt decomposed, be magnesian or aluminous. But the manner in which it is formed, will indicate its character. On dissolving six grains of sulphate of magnesia in four ounces of distilled water, and six grains of alum in

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the same quantity of this fluid, and causing a little ammoniac gas to pass into each of these solutions; the former became instantaneously turbid; but twenty minutes elapsed before the alumine began to be precipitated. Care had been taken to have the phial which contained this mixture very closely stopped. The same phenomena took place with nitrate and muriate of magnesia, and of alumine, dissolved in an equal quantity of distilled water, and treated with the same precautions. The rapidity or slowness with which a mineral water is precipitated by the addition of ammoniac gas, is therefore a criterion by which we may distinguish the nature of the terrene salt which that alkali decomposes. In general, salts with a base of magnesia are much more common in water, than salts with a base of aluminous earth. I must not forget to mention a fact related by Bergman: Ammoniac will form, with sulphate of magnesia, a compound in which a portion of that neutral salt, not decomposed, is combined with a portion of ammoniacal sulphate. Perhaps this undecomposed portion of the sulphate of magnesia forms, with the ammoniacal sulphate, a mixed neutral salt, resembling ammoniacomercurial muriate, or *alembroth salt*. Ammoniac, therefore, precipitates only a part of magnesia, and cannot indicate the exact quantity of *Epsom-salt* to which it serves for a base. I would therefore prefer lime-water for ascertaining the nature and the quantity of salts with a base of magnesia contained in mineral waters. It possesses likewise the property of precipitating salts with a base of aluminous earth, much more speedily,

speedily, and in much greater abundance than ammoniac gas*.

Concentrated sulphuric acid produces a dull white precipitate in water, containing barytes: but as this earth is but very seldom found in mineral waters, I pass to the other effects of this reagent. When it produces bubbles in any mineral water, it indicates the presence either of chalk, carbonate of soda, or pure carbonic acid. The presence of each of these substances, is distinguished by some peculiar phenomena. When we heat water, containing chalk, after pouring into it sulphuric acid, there are speedily formed a pellicle, and a sediment of sulphate of lime; which does not happen on the same occasion to waters simply alkaline. It would, at first, appear, that sulphate of lime must be precipitated as soon as sulphuric acid is poured into water containing chalk: but this very seldom happens without the help of heat; as these waters generally contain an excess of carbonic acid, which promotes the solution of sulphate of lime; and they must be deprived of that acid before the salt can be separated. Convincing evidence of this fact may be obtained by pouring a few drops of concentrated sulphuric acid into a certain quantity of lime-water, precipitated and afterwards clarified by carbonic acid. If the lime-water contain a good deal

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of

* The Reader will perceive, that I am repeating several facts which have been previously mentioned in the course of the work. I have made no scruple of doing so, in order to render this little treatise on the analysis of mineral waters the more intelligible and complete; and in order to exhibit together, all those principles and facts concerning the processes for analysing them, which it appears so absolutely necessary for him to possess who engages in experiments of this nature.

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of regenerated calcareous earth, a precipitate of sulphate of lime will be formed, either in a few minutes, or more slowly, and in proportion as the free carbonic acid is separated. If a precipitate be not formed simply by rest, which happens when the water contains but little sulphate of lime, and a considerable excess of carbonic acid, exposure to a gentle heat will produce in the liquor a pellicle and a precipitate of calcareous sulphate.

The red nitrous acid is recommended by Bergman for precipitating sulphur from *hepatized* waters. To prove the certainty of the fact, all that is necessary, is, to pour a few drops of this ruddy fuming acid into distilled water, into which gas disengaged by acids from caustic alkaline sulphure has been previously introduced, through a pneumatoc-chemical apparatus. This artificial *hepatized* water, which differs from natural sulphureous waters in being more highly charged with mineralizing matter, and consequently liable to be more easily decomposed, affords a precipitate with nitrous acid, in the space of a few moments. This precipitate is of a yellowish white colour: when collected on a filter and dried, it burns with the flame and smell peculiar to sulphur, of which it possesses all the characteristic properties. It appears that nitrous acid alters sulphurated hydrogenous gas, as well as all other inflammable matters, in consequence of its containing such a quantity of oxygen, in that particular state in which it exists in it. Scheele has recommended the oxygenated muriatic acid for precipitating sulphur from these same waters. Only a very little of it must be used; for any extraordinary quantity burns the sulphur, and reduces

it to sulphuric acid, as I have observed of the water of Montmorency. The sulphureous acid precipitates sulphur from mineral waters with great facility.

No reagent is more imperfectly known, in respect to the manner in which it acts, than the alkaline lixivium of blood, called *phlogificated alkali*. Chemists have long ago observed, that this liquor contains Prussian blue ready formed. It was thought that this blue might be separated from it by an acid; and it has been proposed, in this state, as a substance capable of detecting iron in mineral waters. Nothing can be more uncertain than the compleat separation of prussiate of iron from this prussiate of potash made with blood. It ought therefore not to be employed as a reagent. Macquer, in consequence of his discovery concerning the decomposition of Prussian blue by alkalis, has proposed the use of potash saturated with the colouring matter of this blue, for the purpose of ascertaining the existence of iron in mineral waters. However, as this liquor still contains a little Prussian blue that may be separated by an acid as Macquer has directed, M. Baumé advises to add to this Prussian alkali, two or three ounces of distilled vinegar to the pound, and to digest it by a moderate heat till the whole of the Prussian blue be precipitated. Pure fixed alkali must then be poured in, to saturate the acid of vinegar. Notwithstanding the ingenuity of this process, I have had occasion to observe, that this Prussian alkali purified by vinegar, deposits blue, at the end of a long time,—especially if evaporated. M. Gioanetti made the same observation, when he evaporated to dryness a quantity of Prussian alkali purified according to M.

Baume's directions. He has proposed two different processes for rendering this liquor more pure, and freeing it of every particle of iron. In the one, he directs to supersaturate Prussian alkali with distilled vinegar, evaporate it to dryness by a gentle heat, dissolve the mass remaining in the distilled water, and filtrate the solution. All the Prussian blue remains on the filter and the liquor contains no more of it. The other process consists in neutralizing this alkali with a solution of alum, filtrating the liquor, and separating the sulphate of potash by evaporation. These two liquors afford not an atom of Prussian blue with pure acids, nor yet by evaporation to dryness. Lime-water, saturated with the colouring matter of Prussian blue, of which I have spoken under the article *iron*, does not require all these operations. When poured on a solution of sulphate of iron, it instantaneously forms a pure Prussian blue, without any mixture of green. Acids precipitate from it nothing but a few particles of blue. It therefore contains no iron; and is preferable to Prussian alkali for the purpose of assaying mineral waters. The cause of this phenomenon must doubtless be, that lime dissolved in water does not act near so powerfully on iron as alkalis. This prussiate of lime appears to me very proper for detecting iron in ferruginous waters, whether gaseous or sulphuric. In fact, as the carbonic gas which holds iron in solution in waters is of an acid nature, it decomposes Prussian lixivium by double affinity, just as well as sulphate of iron does. I tried prussiate of lime on the waters of Spa and Passy: I instantaneously obtained, in that of Spa, a discernible blue, and in that of Passy, a very copious blue. Here, therefore, is a
liquor

liquor, which may be very easily prepared, and contains no Prussian blue ; and is therefore very proper for the purpose of indicating the presence of even the smallest quantity of iron in waters. It is a sort of neutral salt, formed by the combination of the Prussic acid, or the colouring part of Prussian blue with lime. I have observed, in the history of iron, that M. Scheele has deduced the same inference as I have done, concerning the utility of this reagent ; of which I published an account in the year 1780.

Nut-gall, and all four astringent vegetable substances, oak-bark, the fruit of the cypress tree, the husks of nuts, &c. precipitate solutions of iron, and communicate to that metal different colours, according to its quantity, its particular state, and the state of the water in which it is dissolved. There are a vast variety of shades of this colour, from a pale rose colour to the deepest black. It is acknowledged, that water's deriving a purple colour from a mixture of tincture of nut-gall, is no proof that iron exists in it in a metallic state ; for sulphate and carbonate of iron likewise take a purple colour by the infusion of nut-gall. It is rather the quantity of the iron, the degree of its adherence to the water, and the stage to which the decomposition of the solution is advanced, to which the diversities of colour, observable in these precipitations, are to be ascribed ; as has been very well observed by M. Duchanoy, in his *Essay on the Art of forming Factitious Mineral Waters*. We have formerly mentioned, that the astringent principle is in some measure a peculiar acid, as it combines with alkalis, gives a red tinge to blue vegetable colours, decomposes alkaline sulphures, and combines with metallic

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tallic oxides. To ascertain the presence of iron in a mineral water, powder of nut-gall, a cold infusion of the same substance, and a tincture formed from it with alcohol are employed. The tincture is preferred to the other two preparations; being much less liable to alteration than the solution in water, which soon becomes mouldy. What is more singular, the products of distilled nut-gall likewise colour ferruginous solutions. The solution of it in acids, in alkalis, in oils, or in æther, exhibits the same phenomenon. The iron which this matter precipitates from acids is in the state of a gallate of iron: it is a sort of neutral salt, which, though very black, is not subject to the attraction of the magnet. It dissolves slowly, and without any perceptible effervescence in acids. The action of fire deprives it of these properties, and renders it subject to attraction. Nut-gall is so powerful a reagent, that one drop of its tincture will, in the space of five minutes, colour water containing sulphate of iron, only in the proportion of one twenty-fourth part of a grain to nearly three pints. All these phenomena depend on the matter of the nut-gall being very combustible, and readily carrying off from the iron, a portion of its oxigene, so as to reduce it to the state of a black oxide or ethiops, of which the smallest quantity is very perceptible in transparent liquors.

The two last reagents which we shall propose to be used in examining waters, are the solutions of silver and mercury in the nitric acid. These solutions have been used to detect the sulphuric and the muriatic acid in mineral waters. But several other substances will also precipitate them, which contain not a particle of either of
those

se acids. The white ponderous stræ which the solution of silver produces in water containing muriate of soda, only in the proportion of half a grain to the pint, is precipitated, in a very simple and unequivocal manner, by the presence of the acid of that salt : But they do not, in the same manner, detect the sulphuric acid ; for, by Bergman's calculation, at least thirty grains of sulphate of soda to the pint, are necessary to its producing a sensible effect. Add to this, that fixed alkali, chalk, and magnesia, precipitate the nitric solution of silver in a much more distinct manner. The precipitation of silver in mineral water by this solution cannot therefore serve to determine, in a precise manner, to what saline or earthy substance its mineralization is owing.

The solution of mercury by the nitric acid, is still more liable to occasion mistakes. It not only indicates the presence of the sulphuric and the muriatic acids in waters, but is also precipitated in a yellowish powder, by alkaline and earthy carbonates ; a property which might occasion mistakes with respect to the sulphuric acid. It is commonly thought, that the very copious white precipitate which it produces in water, must be owing to the presence of a muriatic salt ; but mucilages and extractive substances display the same phenomenon,—as is at present well known to all chemists. Besides these errors and uncertainties to which we are liable in applying the nitric solution of mercury to this purpose, in consequence of its producing the same precipitate with various substances, the state of the solution itself is likely to occasion others ; of which we need to be aware, in order to avoid some blunders of no small consequence, which we may otherwise commit in analysing waters. Bergman
has

has taken notice of a part of the singular diversities observable in this solution, in consequence of its being prepared hot or cold,—especially with respect to the colour of the precipitates which it affords by different intermedia: But he has not said a word concerning the property which this solution possesses, of being liable to precipitation by distilled water, when highly saturated with the mercurial oxide; although M. Monnet had announced this fact in his *Treatise on the Solution of Metals*. As this is a matter of great importance in regard to the analysis of waters, I therefore engaged in a more particular examination of it, with a view to ascertain and establish, at least something concerning it; and I succeeded, as I am about to relate by a very simple process. I made a great many solutions of mercury in very pure nitric acid, with different proportions of the two substances, hot and cold; and using acids of various degrees of strength. The following were the results of my experiments.

1. Solutions prepared cold, are with more or less rapidity, charged with a quantity of mercury, which is greater or smaller, according as the nitric acid is more or less concentrated. But, whatever quantity of mercury a concentrated acid may have dissolved cold, this solution is never precipitated by water. I dissolved, in cold, two drachms and a half of mercury, in two drachms of red, and highly fuming nitrous acid: the whole weighed in a bottle containing an ounce of distilled water, one ounce, four drachms, and five grains. The combination took place with amazing rapidity: more than one fourth of the acid was lost in very thick nitrous gas, and in aqueous re-

pours

pours exhaled by the heat of the mixture. This solution was of a dark-green colour, and very transparent. I poured some drops of it into half an ounce of distilled water: there were immediately formed some whitish fuzes, which were dissolved by shaking, and did not yield a precipitate. This, however, was the most concentrated solution that I could prepare in a cold temperature: it displayed the most considerable motion and effervescence, and yielded the largest quantity of ruddy vapours. As it had deposited crystals, I added two drachms of distilled water, which dissolved the whole, without exhibiting any appearance of a precipitation. Such, therefore, as are prepared in a cold temperature, with common nitric acid, and half their weight of mercury, can be in no danger of being precipitated by water, and may be confidently employed in the analysis of mineral waters.

2. However weak the nitric acid, when exposed over mercury to a considerable heat, it dissolves more of the metal than the same acid cold will dissolve, even in the strongest state. The solution is of a light yellow colour, and fat and thick: by rest, it precipitates a yellowish shapeless mass, which, with boiling water, may be changed into a yellow oxide, or beautiful *turbith*. This solution, when poured into distilled water, forms a very copious precipitate, of a yellow colour resembling *turbith*. A solution prepared in a cold temperature, will exhibit the same result, if exposed to a heat so intense as to make it exhale a good deal of nitrous gas. These heated solutions should not be employed in the analysis of mineral waters; for they are decomposed by distilled

3. The only difference between these two sorts of solutions appears to be, that there is a much larger quantity of mercurial oxide in that which is precipitated by water, than in that which is not decomposable in the fluid. I proved this truth by a comparative evaporation of equal quantities of the two solutions, in medical phials, in order to reduce them to red precipitate. I obtained, from the solution which is liable to precipitation by water, one-fourth more than from the other. The specific gravities likewise afford a criterion, by which the respective proportions of the oxide of mercury in these different liquors may be estimated. I compared the weights of equal quantities of three different solutions of mercury. One of them, which yielded no precipitate in distilled water, and had been formed by the first of the above-mentioned operations, weighed one ounce, one drachm, and sixty-seven grains, in a bottle containing an ounce of distilled water. The second, which had been prepared by a very gentle heat, communicated a light opaline colour to distilled water, without producing any very discernible precipitate: it weighed, in the same bottle, one ounce, six drachms, and twenty-four grains. Lastly, the third of these mercurial solutions, which was pretty hot, and precipitated a true turbith mineral, of a dirty-yellow colour in distilled water, weighed one ounce, seven drachms, and twenty-five grains. I had still one decisive experiment to make, which might either confirm or refute my opinion. If the solution which afforded a precipitate in distilled water, owed that property to its containing an excess of mercurial oxide; in that case, the addition of

more

more acid might be expected to render it incapable of yielding a precipitate; and this actually happened. On pouring aquafortis into a solution which was decomposable by water, it was immediately rendered incapable of yielding a precipitate to that fluid, and reduced into the same state with that which is prepared slowly, without the application of any greater heat than the temperature of the atmosphere. M. Monnet has already recommended this process, to preserve crystals of mercurial nitrate from being reduced to oxide by the contact of the air. By a contrary process, and by evaporating a portion of the acid of a good solution not susceptible of precipitation by water, it may be reduced to a solution containing a much larger proportion of mercurial oxide, and consequently susceptible of decomposition by water. It may be restored to its former state, by adding a quantity of acid equal to what it has lost.

These considerations appeared to me of importance, in order to render the effects of reagents on water somewhat less uncertain. But, whatever the accuracy with which we proceed in these researches, however extensive our knowledge of the degrees of purity, and the different states of the substances which are combined with mineral waters, in order to discover their principles; if it must be acknowledged, that each of those reagents indicates the presence of two or three different matters; we must be always at a loss to ascertain the particular nature of the results which they at any time produce. Lime, for instance, seizes carbonic acid: it precipitates both salts that have alumine or magnesia for their base, and metallic salts: Ammoniac produces the same effect: fixed alkali precipitates both
these

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these and calcareous salts: calcareous prussiate, prussiate of potash, and gallic alcohol, precipitate sulphate and carbonate of iron: the nitric solutions of silver and mercury decompose all sulphuric and muriatic salts, however different, or however mingled together in the same water:—they are also decomposed themselves, by alkalis, chalk, and magnesia. Amid these complicated phenomena, how is it possible to discern the peculiar nature of any alteration produced in water by any of those reagents, or to distinguish, from their operation, whether the water be simple or compound? |

These questions, though very perplexing at a time when chemistry was not conscious of all her strength, may now, however, be discussed, even with hopes of resolving them in a satisfactory manner.—In the first place, I observe, that the nature of reagents is much better known than it was a few years ago, and their reaction on the principles of waters much more accurately determined; and, from these circumstances, there is good reason to think, that they may now be used with much more advantage than has been hitherto imagined. Yet, among the many skilful chemists who have employed their labours in the analysis of waters, none but M. Baumé, Bergman, and Gioanetti, have had any idea of the advantages which may be derived from a more liberal use of those substances. Chemists have long been in use to examine mineral waters by reagents in very small quantities, and commonly in glasses: the phenomena of the precipitation produced in this case are carefully observed, but the experiment is carried no farther. M. Baumé, in his Chemistry, advises to saturate a certain quantity of mineral water which you
with

with to examine, with fixed alkali and acids, to collect the precipitates, and examine their nature. Bergman thinks, that from the weight of the precipitates obtained from such mixtures, the quantity of the mineralizing principles contained in the waters may be estimated. Other chemists, too, have tried this method; but always with some particular views: Nobody has ever thought of making a regular and complete analysis of mineral waters by this process. To accomplish it, in my opinion, several pounds of mineral water should be mixed with each reagent, till the reagent cease to produce a precipitate from the water. It may be left for the space of twenty-four hours in a close-stopped vessel, to deposite the precipitate;—then filtrate the mixture, and, after weighing and drying it on a stove, examine the precipitate which remains on the filter by the usual methods. Thus you may discover, with certainty, the nature of the substance on which the reagent has acted, and determine the cause of the decomposition which it has produced. Order may be observed in these operations, by first mixing the waters with those substances which are least capable of altering them, and proceeding to the application of such substances as may produce on them a greater variety of changes, and those most difficult to estimate. I usually proceed in the following manner in this sort of analysis. After examining the taste, colour, weight, and all the other physical properties of a mineral water, I pour four pounds of lime-water on an equal quantity of the fluid which I am examining: if no precipitate is formed in the space of twenty-four hours, I am sure that the water contains

neither free carbonic acid, alkaline carbonate, neutral salts with a base of aluminous earth or magnesia, nor metallic salts. But when a precipitate is either instantaneously or gradually formed, I filtrate the mixture, and examine the chemical properties of the sediment. When the sediment has no taste, is insoluble in water, effervesces with acids, and forms with the sulphuric acid an insipid salt, almost insoluble in water; I conclude that it is chalk, and that the lime-water has taken up no principle but carbonic acid from the mineral water. Again, when the precipitate is but scanty, is not readily deposited, produces no effervescence, and affords with sulphuric acid a styptic, or bitter, and very soluble salt, it must then consist of magnesia or aluminous earth, or possibly of both. I need not here enlarge upon the means for distinguishing between these two substances; they must be already well known. I shall only add, that such a variety of those means may be used, as to leave no doubt with respect to the nature of the substance precipitated.

After this process of examination with lime-water, I pour on the same mineral water one or two drachms of very caustic ammoniac, or introduce into it ammoniac gas, disengaged from that liquid salt by heat. When the water is saturated, I leave the mixture to rest in a close vessel for four and twenty hours: If I then find a precipitate formed, as it can be owing only to either ferruginous salts, or to salts with a base of magnesia or alumine, I examine its nature by the different operations mentioned above, under the account of the trial by lime. But as ammoniac gas does not act in so uniform a manner as lime-water, which effects the same decompositions,

otions, it is proper to observe that this gas is to be employed only as an auxiliary, from which such accurate results are not to be expected as from the operation of the preceding reagent.

After the salts with a base of aluminous earth or magnesia, have been discovered with lime-water or ammoniac; potash or soda will detect those having a base of lime, such as calcareous sulphate, and calcareous muriate. With this view I precipitate a few pounds of the water which I examine, with either of these fixed alkaline liquors, till such time as the water ceases to be turbid. As the alkali decomposes salts having a base of luminous earth, as well as those which owe their formation to lime;—if the precipitate resemble that which is obtained by the application of lime-water, in form, colour, and quantity, I presume that the water contains no calcareous salt; and this conjecture is usually confirmed by a chemical analysis. But when the mixture becomes much more turbid than that which was formed with lime-water, and when the sediment is more ponderous and copious, and sooner deposited; I then infer, that it contains lime with a mixture of magnesia, or alumine. I ascertain this, by treating the sediment by the different operations for the purpose, already described. It may be naturally conceived, that the iron precipitated by reagents, at the same time with the ferro-terrene substances, must be distinguishable by its colour and taste, and that the quantity of the metal separated by these processes, must be too small to have any influence on the results.

I need not here explain what substances the sulphuric acid, the nitrous acid, nut-gall, and calcareous and

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alkaline pruffiates, are capable of precipitating, when used as reagents. What I have said above on the general effects of these matters, may be considered as sufficient. I shall only add, that when mixed in a large proportion with mineral waters, they produce precipitates, from an examination of which we may ascertain the nature and the proportions of their principles; a process which has been performed by Messrs Bergman and Gioanetti.

A consideration of the products which nitric solutions of silver or mercury produce in mineral waters, will detain us longer. These are the best reagents for examining large quantities of water, when we wish to ascertain the nature of the acids which waters may contain. Mineral waters may be considered as completely analysed, when the acids which they contain are known: for the acids are generally combined with some of the bases liable to be detected by the preceding reagents. The colour, form, and quantity of the precipitates formed by solutions of mercury and silver, have hitherto been regarded by chemists as indicating sufficiently the nature of the acids to which their formation is owing. A thick, weighty sediment, instantaneously formed, indicates the presence of the muriatic acid. If scanty, white, and crystallized, with nitrate of silver,—yellowish and shapeless with nitrate of mercury, and in both instances but slowly deposited, it is then to be ascribed to sulphuric acid. However, as these two acids are often found together in the same water, and as alkali and lime likewise decompose these solutions, the results are rather uncertain, unless we attend at the same time to the physical properties of the precipitates. They must, therefore, be
examined

examined in a more particular manner. To this end, mix the solutions of silver and mercury with five or six pounds of the water which you wish to analyse; at the end of twenty-four hours, filtrate the mixtures, dry the sediments, and then treat them with the usual processes. On heating in a retort the precipitate produced by the nitric solution of mercury, the portion of that metal which combines with muriatic acid, volatilizes into mild mercury; and that which is combined with sulphuric acid, remains at the bottom of the vessel, and is of a reddish colour. These two salts may be likewise distinguished from each other, on this occasion, by the phenomena which they exhibit on burning coals. Sulphate of mercury exhales sulphureous acid, and takes a red colour; mercurial muriate remains white, and is volatilized without diffusing any smell of sulphur. These phenomena likewise serve to enable us to distinguish such precipitates as may be formed by alkaline substances contained in waters; for alkaline substances never give out a sulphureous smell, nor are they volatile without decomposition.

The precipitates produced by the combination of mineral waters with the nitric solution of silver, may be examined with the same facility. Sulphate of silver is more soluble than muriate of silver; and these two salts are therefore separable by distilled water. Muriate of silver may be distinguished by its fixity and fusibility, and still more readily by its being less decomposable than sulphate of the same metal. Sulphate of silver, when put upon coals, exhales a sulphureous smell, and leaves an oxide of silver, which may be melted without any addition. I am not to speak here of all the chemical

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processes which might be adopted to distinguish between and to separate these two salts of silver. It is enough, that some of them are here described.

§ VI. *Examination of Mineral Waters by Distillation.*

DISTILLATION is used in the analysis of mineral waters, to distinguish the gaseous substances which they may happen to contain. Those substances are either air, more or less pure, or carbonic acid, or sulphurated hydrogenous gas. To distinguish the nature and the quantity of the gaseous substances contained in any mineral water, take a few pounds of the water, and put them into a retort of such a size that they may fill it only one half or two thirds full. To this vessel adapt a curve tube, entering by its other end, into a glass filled with mercury. When the apparatus is thus disposed, heat the retort till the water fairly boil, or till elastic fluid cease to pass into the glass containing the mercury. When the operation is ended, abstract from the bulk of the gas obtained, the air that was contained in the empty part of the retort. The rest is the æri-form fluid that was contained in the mineral water, the nature of which may be soon known, by trying it with a lighted lamp, or tincture of turnsole, or lime-water. If it take fire, and emit a fetid smell, it is sulphurated hydrogenous gas: If it extinguish a taper, redden turnsole, and precipitate lime-water, it must be carbonic acid: Lastly, if it maintain combustion without exhibiting flame, if it be inodorous, and if it alter neither turnsole nor lime-water, it is then atmospheric air. The atmospheric air thus obtained from mineral waters may
happen

happen to be purer than the common air of the atmosphere. We can then judge of its purity from the manner in which it contributes to combustion, or by mixing it with nitrous or hydrogenous gas in Messrs Fontana and Volta's eudiometers. The process employed to obtain gaseous matters from mineral waters, is entirely the invention of modern chemistry. Formerly, they for this purpose used a wet bladder, which was fitted to the mouth of a bottle full of mineral water. The fluid was then shaken; and from the manner in which the bladder was swelled, an idea was formed of the quantity of gas contained in the water. We know, at present, that this operation is not to be depended upon; for water never gives out all its gas without ebullition; and the sides of a wet bladder alter the elastic fluid which is obtained, and destroy its nature. It is not necessary to take notice, that the phenomena which take place in the water, when gas is separated, should be carefully observed; and that when the taste, the lightness, and the sparkling of the water, shew it to contain a large proportion of gas, the quantity of it submitted to distillation should then be proportionably smaller.

Such is the operation recommended by modern chemists for the extracting of elastic fluids from waters. I shall observe, 1. That with respect to acidulous waters, this process cannot be depended upon, without a very accurate calculation of the weight of the air, and the degree of pressure to which the elastic fluid is exposed in the glasses;—and that, as it is very difficult to estimate these with sufficient accuracy, the absorption of this acid by lime-water, as has been proposed by M. Gioanetti, appears preferable. 2. Though it be recommended by

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Bergman for the extracting of sulphurated hydrogenous gas from sulphureous waters, it will not answer this end; for boiling heat decomposes this gas; and it is likewise decomposed by mercury, which passes into the state of æthiops, as soon as it comes into contact with this elastic fluid. On this account, in my analysis of the waters of Enghien, near Montmorency, I have proposed the use of litharge for the absorption of this gas in a cold state, and for purifying sulphureous waters from all the sulphur which they contain.

§ VII. *Examination of Mineral Waters by Evaporation.*

EVAPORATION is generally considered as the most certain mode of obtaining all the principles contained in mineral waters. We have above observed, what we may here repeat, from the experiments of Messrs Venc and Cornette, that long boiling may happen to decompose saline matters dissolved in waters; for which reason, we have rather recommended the use of reagents. Evaporation, however, affords so much additional information, when employed together with the analysis by reagents, that it will be proper to give a particular account of the best method for conducting it.

As the purpose of this operation is, to obtain the fixed principles of mineral water, it is evident, that in order to distinguish the nature and proportion of those principles, a certain quantity of the water must be submitted to the operation; and accordingly, the weaker the proportion in which those principles exist in the water, so much the more of that fluid should be used. Twenty pounds of the water may be sufficient, when it contains

contains a good deal of saline matter. But when only a very small proportion of such matter appears to be dissolved in it, a much larger quantity must be evaporated; at times, even no less than some hundred pounds. The nature and shape of the vessels in which mineral waters are exposed to evaporation, are not matters of indifference. Those made of any metal, except silver, are liable to be altered by water: glass vessels, again, of a certain size, are very likely to crack or split: vessels of very compact and well varnished earth, are the most suitable for this purpose, although, when the varnishing cracks, they are liable to absorb the saline matters. Vessels of porcelain, without a coating, would, no doubt, be the most answerable; but these again are too dear. Chemists have proposed different methods of evaporating mineral waters. Some advise to distil them to dryness in close vessels, that no extraneous substances from the atmosphere may mix with the residue; but this operation is too tedious. Others recommend evaporation by a moderate heat, not sufficient to make them boil; as a boiling heat is believed to alter their fixed principles, and to deprive them always of a certain part of those principles. This is the opinion of Venel and Bergman. M. Monnet, on the contrary, would have us to boil the water; as its motion, when boiled, prevents extraneous matters to insinuate themselves from the atmosphere. Bergman, to avoid this inconvenience, directs us to cover the evaporatory vessel with a lid having a hole in the middle, through which the vapours may make their escape. This last method greatly retards the evaporation, as it diminishes the surface of the fluid in so considerable a degree. It may be employed, at
first,

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first, till the vapours become strong enough to remove the dust. But the chief difference among chemists, in respect to the mode of conducting this operation, is, that some follow Boulduc in separating the substances which are deposited as the evaporation goes on, in order to obtain each of the principles of the water in a pure, insulated state ; whereas others would have the evaporation carried on to dryness, before any such separation be attempted. I agree with Bergman, in thinking this last method the most expeditious and the most certain : for whatever be the precautions adopted in following the former method, in separating the different matters as they are deposited or crystallised, they are never obtained pure, but always need to be examined by a farther analysis. Besides, this method is never exact, on account of the loss occasioned by so many filtrations : lastly, it is very difficult and perplexing, and renders the evaporation exceedingly tedious. Mineral waters should then be evaporated to dryness in glass capsules, on a water-bath : it would be still better to use glass retorts on a sand-bath.

During the course of this evaporation, different phenomena are observed. When the water is acidulous, it appears full of bubbles, as soon as the heat begins to make an impression upon it : while the carbonic acid is disengaged, a pellicle and a sediment are formed, consisting of chalk and carbonate of iron : after the formation of these pellicles, there is a crystallisation of sulphate of lime : lastly, muriates of potash and soda are crystallised in cubes on the surface ; and, to obtain the deliquescent salts, the evaporation must be continued to dryness.

Let

Let the residue then be weighed, and put into a small phial, with three or four times its weight of alcohol. Shake the whole, and after letting it rest for a few hours, filtrate it; preserve the liquor apart, and dry, by a gentle heat, or in the air, that portion of the residue on which the spiritous fluid has not acted. When sufficiently dry, it is to be carefully weighed; and the loss which it has suffered shews what quantity of calcareous or magnesian muriate it contained, as these salts are very soluble in alcohol. We will speak afterwards of the method of ascertaining the existence of these two salts in this spiritous fluid.

The residue, when properly dried, is next to be diluted with eight times its weight of cold distilled water; and this mixture, after being left to settle for several hours, must be filtrated. The residue is again dried, and then boiled half an hour in four or five hundred times its weight of cold distilled water. It is next to be again filtrated; and after this last operation, there remains only what the cold water and the boiling water have been insufficient to dissolve. The cold water would take up the neutral salts, such as sulphate of soda or magnesia, muriate of soda or potash, and fixed alkalis, especially soda combined with carbonic acid. Boiling water in a large proportion, dissolves only sulphate of lime. There are therefore four substances to be examined after these different operations on the matter obtained by evaporation: 1. The residue which is insoluble in alcohol, and in water in different temperatures: 2. Salts dissolved in alcohol: 3. The salts which have been taken up by the cold water: 4. Lastly, Those which have been taken up by the boiling water. We

now proceed to the experiments for distinguishing these different substances.

1. The residue which has withstood the action of alcohol, and of cold and hot water, may consist of calcareous earth, of carbonate of magnesia and iron, of alumine, and of quartz. The two last of these substances are very rarely to be found in waters, but the three first are very common. A lighter or deeper brown or yellow colour, indicates the presence of iron. When the colour of the residue is a light grey, it contains no iron. When it contains any of that metal, Bergman advises to moisten it, and expose it to the air till it rusts. Vinegar then no longer acts upon it. To explain the methods for separating these different matters, let us suppose an insoluble residue, consisting of all the five substances which we have allowed that it may contain. We must begin with moistening and exposing it to the rays of the sun. When the iron is sufficiently rusted, the residue may be digested in distilled vinegar. This acid dissolves the lime and magnesia. By evaporating the mixture, we obtain calcareous acetite, which is distinguished from acetite of magnesia by not attracting moisture from the atmosphere. These two salts may be separated by deliquescence, or rather by pouring some sulphuric acid into the solution containing them. The sulphuric acid forms sulphate of lime, which is precipitated: if there were any magnesian acetite, the sulphate of magnesia, formed by the sulphuric acid, would remain dissolved in the liquor, and might be obtained by an evaporation judiciously conducted. To ascertain the quantity of the magnesian and calcareous earths contained in this residue, precipitate the
sulphates

fulphates of lime and magnesia formed by the sulphuric acid poured into the acetous solution with carbonate of potash, and weigh the precipitates. When the chalk and magnesia of the residue are separated, only iron, alumine, and quartz remain. The iron and alumine are detached by means of pure muriatic acid, which dissolves both these salts. The iron is precipitated by prussiate of lime, and the alumine by carbonate of potash: the two substances are then weighed to determine the quantities. The matter which remains after the separation of the alumine and the iron, is usually quartzose. Its quantity is ascertained by weighing it; and its nature, by melting it with carbonate of soda, by means of the blow-pipe. These are the most accurate processes which have been recommended by Bergman, for the examination of the insoluble residue of mineral waters.

2. The alcohol which was used in washing the dry residue of the waters, is next taken and evaporated to dryness. Bergman directs to treat it with sulphuric acid diluted in water, in the same manner as the acetous solution above taken notice of. But it is to be observed, that by this process only the base of those salts is discovered. To determine the nature of the acid, which is usually united with magnesia or lime, and sometimes with both in this residue, we must pour upon the dry residue a few drops of strongly concentrated sulphuric acid, which produces an effervescence, and disengages muriatic acid gas, that makes itself known by its smell and white vapour, when the salt under examination owes its formation to that acid. Its existence may likewise be ascertained, by dissolving the whole residue in water, and mixing with it a few drops of the nitric solution

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lution of silver. With respect to the base, which, as we have already mentioned, consists either of lime or of magnesia, or of both; the quantity and the nature of its principles may be also determined by sulphuric acid, by the same process which has been explained above, in speaking of the application of the acetic acid.

3. The lixivium of the former residue of the mineral water, prepared with eight times its weight of cold distilled water, contains alkaline neutral salts, — such as sulphate of soda, muriates or marine salts, carbonate of potash or soda, and sulphate of magnesia. Sometimes, too, there is a small quantity of sulphate of iron. These salts never exist altogether in mineral waters. Sulphate of soda and carbonate of potash, are but very seldom found in mineral waters; but marine salt is often found in them, in union with carbonate of soda. Sulphate of magnesia likewise exists pretty often in such waters; and they are even sometimes found to contain it in a pretty considerable quantity. When this first washing of the residue of a mineral water contains only one neutral salt; that salt may be very easily obtained by crystallisation, and its nature may be known by its form and taste, and by the manner in which it is affected by fire and reagents. But this case is very rare; and it happens much more frequently, that a number of salts are united together in this lixivium: We must then endeavour to separate them by slow evaporation. Even this method does not always fully succeed, with whatever care this first lixivium may be evaporated: each of the salts obtained at different times by evaporation, must be examined anew. It is most commonly carbonate of soda which is deposited in a confused manner among the
muriatic

nuriatic salts. These may be separated by a process described by M. Giaconetti: It consists in washing this mixed salt with distilled vinegar;—that acid dissolves the carbonate of soda: Dry the mixture, and wash it anew with alcohol;—the alcohol takes up the acetite of soda, without acting upon the marine salt: Evaporate the spiritous solution to dryness, and calcine the residue;—the vinegar is decomposed and burnt. Nothing remains after this but soda, the exact quantity of which is known.

4. The lixivium of the former residue of mineral water, prepared with four or five times its weight of boiling water, contains nothing but sulphate of lime. Accordingly, pure caustic ammoniac produces no change upon it; but caustic potash forms in it a copious precipitate. By evaporating the lixivium to dryness, the quantity of terrene salt which it contains is exactly known.

§ VII. *Of Factitious Mineral Waters.*

THE processes which have been described for the examination of the residues obtained by the evaporation of mineral waters, are sufficient for discovering, with the utmost accuracy, whatever different substances may be dissolved in those fluids. Yet we must still advance a step farther, in order to confirm the results of our analysis: We must imitate nature by a synthetic process, and dissolve in pure water the several substances obtained by analysis, from the mineral water which we have been examining. If the factitious mineral water thus formed, have the same taste and weight, and exhibit the same phenomena with reagents as the natural mineral water which was analysed,—no fuller proof can be required

of the accuracy of the analysis. Such artificial combinations happily supply, at all times, in all places, and at a small expence, medicines equally useful for the cure of diseases, with natural mineral waters, whose properties are liable to be altered by conveyance from one place to another, and by many other circumstances.

The most celebrated chemists are of opinion, that natural mineral waters may be imitated by art. Macquer observes, that since the discovery of the carbonic acid, and since its power of rendering a great many substances soluble in water has been taken notice of, it is become much easier to prepare factitious mineral waters. Bergman has given directions for the preparation of factitious Spa, Seltz, Pyrmont, &c. waters. In Sweden, he informs us, such waters are used with great success; and he himself had experience of their good effects. M. Duchanoy has published a work, in which he gives a series of processes for the artificial preparation of all the mineral waters used in medicine. We have therefore good reason to hope, that chemistry may render the art of medicine some important services, by supplying such valuable medicines, and by weakening and increasing their energy at pleasure.

DISCOURSE

ON

MODERN CHEMISTRY *in General, and on its* FIRST PRINCIPLES.

IN tracing the history of chemistry for these last twenty years, we find, that, in consequence of the discovery of the different elastic fluids, and their properties, Stahl's theory has lost much of its credit : Chemists have been for some time in doubt, whether to reject or adhere to it, and have formed various theories,—the number of which is scarce inferior to that of those who are seriously engaged in the pursuits of this science. A good many chemists, however, especially in the north, have not yet adopted any new theory, but continue to connect the theory of Phlogiston with the newly discovered facts. But those who are masters of the science in all its extent, must readily perceive, that the manner in which that connection is formed, is far from being natural or satisfactory ; and that it consists of forced analogies, the inconsistency of which is sufficiently striking.

The doctrine adopted by several French chemists, at the head of whom we must rank M. Lavoisier, who con-

trived and laid the foundations of this system, is not subject to the same difficulties. Its simplicity, its systematic progress, its perspicuity, and the ease with which it is applicable to all the phenomena of chemistry, render it much superior to any of those which still divide such of the philosophers of Europe as have not adopted it. Among the more celebrated of its partisans, this doctrine now boasts of the names of Lagrange, la Place, Black, Kirwan, Van Marum, Bertholet, Monge, Morveau, Chaptal, Charles, Landriani, Schurer, Girtanner, Jacquin the son, Aezula, &c. &c. I have taught this doctrine both in my public and private lectures for these last twelve years. If I might flatter myself with having contributed in any degree to elucidate this system of modern chemical science, either by my lectures and writings, or by such discoveries as I have published within these fifteen years. I must be permitted to observe, that no other theory affords so true and full an explanation of all the phenomena of nature and of the arts. This doctrine has been particularly explained through the whole of this work : But perhaps a short view of it may still be of use to the student ; and I have therefore endeavoured to exhibit, in the following Discourse, a brief account of the principles on which it is founded ; which may render it more striking, and more easily intelligible, and which will accordingly be a sort of abstract of all the leading phenomena, to which the others may be referred as to so many general heads.

In all chemical experiments, one of the two following phenomena is observed : 1. Heat is either disengaged

gaged or fixed: 2. An elastic fluid is either formed or absorbed. After these two general facts are established as invariably certain, it may be naturally conceived, that the properties and action of heat, with the formation and fixation of elastic fluids, are the foundation of the theory of chemistry. These, therefore, are the two great objects which must here engage our attention.

Of Heat, and of the Formation and Fixation of Elastic Fluids.

ALTHOUGH the weight, both of sensible heat, and of combined or latent heat, which we have denominated *caloric*, is at present unknown, and cannot therefore afford any proof of its material or individual existence, yet the whole phenomena of chemistry concur to prove, that it exists as a separate body or substance, possesses certain unvarying properties or characteristics, and is uniformly subject to certain laws of affinity. Besides its power to produce, by its action on our organs, that sensation which we denominate *heat*, philosophers have observed it to possess certain distinctive properties which can belong to no other substance, such as rarefaction, or the separation which heat produces of the component particles of all natural bodies; which, by increasing their bulk, diminishes their reciprocal attraction, and, without enlarging the mass, diminishes, in the same proportion, their specific gravity, and strengthens the affinities between the component particles of different bo-

dies. The greater the quantity of caloric accumulated in any body, the more it is compressed and condensed in that body ; so much the more is its affinity for that body increased ; and in the same proportion too, are the properties of the body changed. Fusion or liquefaction, volatilization or sublimation, the passage of liquids into the form of vapours or elastic fluids, —are effects constantly produced by the penetration of heat into those bodies, or rather by its combination with them. Ice, or water in a solid state, becomes fluid by absorbing a certain quantity of caloric : A larger proportion of the same principle renders it invisible and æthereal. There can be no doubt, that water in a liquid state is a compound of ice with a certain quantity of caloric, and that water in gas or vapour, is equally a compound, of which the principles are the same, but which contains caloric in a larger proportion. Such is the theory of the formation of elastic fluids in general : They are all compounds, consisting of a base more or less solid, and matter of heat or caloric. As this last principle is subject to laws of attraction peculiar to itself ; when it escapes from one body, it combines with some other :—or rather, bodies with which caloric is combined, when they have a stronger attraction for other bodies exhibited to them than for this principle, dismiss it, in order to combine with those other bodies.

There is not a single instance in which these phenomena of the disengagement or fixation of caloric, and the disengagement or fixation of elastic fluids are not observed, either separately or together. From this simple theory,

theory, which is in reality nothing but a statement of facts, it appears that all elastic fluids ought to be distinguished by two names; one denoting their aëriform combination with caloric,—of which sort are the generic words, *air*, or *gas*, the first to be used when those substances are proper for maintaining combustion and respiration, the second when they do not contribute to these purposes; the other, a specific name, denoting the particular base of the gas or elastic fluid. It will accordingly be expected, that, in a recapitulation of all the facts of chemistry, we should give an account of the elastic fluids which are either produced and disengaged, or fixed and absorbed in the various phenomena belonging to this science.

All the elastic fluids whose properties are worthy of notice, may be arranged in four classes.

CLASS I.

Elastic Fluids capable of maintaining Combustion, and the Respiration of Animals.

- Species 1. Vital air.
2. Atmospheric air.

CLASS II.

Elastic Fluids unfit for maintaining Combustion and Respiration, and neither saline nor soluble in Water.

- Species 3. Azotic gas.
4. Nitrous gas.

CLASS III.

Elastic Fluids unfit for maintaining Combustion and Respiration, but of a saline Nature, and soluble in water,

- Species 5. Carbonic acid gas.
 6. Sulphureous acid gas,
 7. Fluoric acid gas.
 8. Muriatic acid gas.
 9. Oxygenated muriatic acid gas.
 10. Ammoniac gas,

CLASS IV.

Elastic Fluids neither proper for maintaining Combustion, nor Respiration, but inflammable.

- Species 11. Hydrogenous gas,
 12. Sulphurated hydrogenous gas.
 13. Phosphorated hydrogenous gas.
 14. Hydrogenous gas mixed with azote.
 15. Hydrogenous gas mixed with carbonic acid,
 16. Carbonaceous hydrogenous gas.

Of the Nature and leading Properties of these different Species of Elastic Fluids.

I. *VITAL AIR*, called by its discoverer, Dr Priestley, *dephlogisticated air*, and by some other English philosophers, *empyrean air*. and *principium forbile*, is at present

present extracted from many different matters. *Precipitate per se*, or oxide of mercury, *red precipitate* or oxide of mercury prepared by nitric acid, precipitates of the several mercurial neutral salts formed by alkalis, red oxide of lead sprinkled with a little nitric acid, alkaline and terrene nitrates, nitrate of silver, native oxide of manganese either by itself or sprinkled with sulphuric acid, oxygenated muriatic acid, mercurial acetate, arseniate of zinc, all give out either more or less of it when exposed to the action of light and heat. Its disengagement is evidently effected by the uniform action of these two principles. It is not contained ready formed in these bodies: they contain only its solid base, which is melted by caloric and light, and thus reduced into an elastic-fluid state; and as it escapes, the oxides by degrees assume the metallic state. It is also obtained from the leaves of plants or trees exposed in water charged with carbonic acid to the action of the rays of the sun.

Vital air is often mixed with a little azotic gas; only, that obtained from oxide of mercury, from oxide of manganese, from super-oxygenated muriate of potash, or from the leaves of plants, is without it.

Vital air is rather heavier than atmospheric air; it is the only elastic fluid which maintains combustion. Pure vital air is four times as powerful for this effect as atmospheric air; that is to say, a body requiring four cubic feet of atmospheric air to effect its combustion, may be burnt with one cubic foot of vital air. Combustion is accompanied with a good deal of light and heat: these two phenomena are occasioned by the rapid separation of the fire, which forsakes the base of

this air in proportion as that base fixes in the burning body. In some instances of combustion effected by this air, only heat, but no light, is disengaged. This happens when the disengagement is accomplished slowly and by degrees. It contributes also in an eminent manner to the respiration of animals: and supplies their blood with the caloric which raises its temperature above the medium in which they live.

The base of vital air, by combination with carbone, fulphur, phosphorus, azote, arsenic, &c. forms the carbonic, sulphuric, phosphoric, nitric, arsenic, &c. acids. It is from its possessing this property, that we have denominated this base oxigene, or the acidifying principle. It is to be observed, 1. That these combinations do not always take place when those combustible bodies are immersed in vital air; and that different degrees of temperature, above the ordinary temperature of the atmosphere, are generally requisite to produce them, at least with sufficient rapidity. 2. That this base or oxigene enters into these compounds in different proportions; and that, according as any base is more or less completely saturated, the compound differs in its nature from other compounds not saturated precisely in the same degree. 3. That its affinity for these different matters is not uniformly the same: accordingly, phosphorus robs the arsenic acid of its oxigene; the phosphoric acid, again, yields its oxigene to coal, &c. 4. That when it passes out of one of those bodies in which it has been fixed in a state very different from that of elastic fluidity, into any other body, a sort of combustion actually takes place; which is indeed slow, and therefore unaccompanied

ied with either heat or light ; as oxigene, in the state in which it exists in such bodies, is combined with but very little of those principles.

Oxigene combined with hydrogene, forms water ; with metals, it forms metallic oxides. Coal decomposes water and metallic oxides at a high temperature ; having then a greater affinity with oxigene, than either hydrogene or metals.

Vital air discolours vegetable and animal substances : When absorbed by fixed oils, it thickens them, and reduces them into a state resembling that of wax. With the muriatic and the acetous acids, it forms oxygenated muriatic acid and acetic acid or radical vinegar.

The heat of the sun, when acting with any considerable energy, disengages oxigene into the state of vital air from many of its combinations ; such as the oxides of mercury, silver, gold, nitric acid, oxygenated muriatic acid, &c.

II. *Atmospheric or common air* is a compound of vital air with azotic gas. One hundred parts of atmospheric air, contain nearly 73 parts of azotic gas and 27 parts of vital air. This explains the reason why only a fourth part of any quantity of atmospheric air is consumed before it becomes unfit for maintaining combustion ; and why the phenomenon of combustion takes place more slowly, and is accompanied with less heat and light in atmospheric, than in pure vital air. But we must observe, that there is not perhaps a single instance of combustion, in which the 27 parts of vital air contained in the common air of the atmosphere, are entirely absorbed and fixed in the combustible body ; and that accordingly the
aëriform

aëriiform residue of atmospheric air remaining after it has contributed to combustion, is scarce ever pure azotic gas, not even when the burnt body remains in a fixed and solid state, without mixing with the elastic fluid. The gas must therefore be still more impure, when the body is burnt under a bell-glass filled with atmospheric air, and affords a residue in a permanent aëriiform state; as charcoal, and all organic matters containing it, do.

There are a number of bodies which alter atmospheric air, by absorbing the vital air which it contains. But we know of none that renew and purify it, except the leaves of vegetables; which, when exposed to the rays of the sun, effect a decomposition of carbonic acid and water, in consequence of which, they afford a supply of vital air to the atmosphere.

III. *Azotic gas*, which exists in the atmosphere in a large proportion, is thus named, because it very soon proves fatal to animals, and extinguishes combustion; and accordingly, appears to be in its nature directly opposite to vital air. Dr Priestly called this elastic fluid *phlogisticated air*; imagining that it derived its noxious properties from phlogiston, disengaged out of burning bodies, or odorate matters;—in a word, from all those operations of nature and art, which he has called *phlogisticating processes*.—It has since been proved, that this fluid exists ready formed in the atmosphere, and is only separated by the absorption of vital air. Modern philosophers have made more important discoveries concerning this, than concerning any other elastic fluid. There are several ways of obtaining pure azotic gas. That which is most generally in use, is the exposing of a quan-

tity of liquid sulphure of potash to a given quantity of atmospheric air under bell-glasses : the vital air is by degrees absorbed ; and when it is entirely absorbed, the azotic gas remains pure. We owe this process to Scheele. M. Berthollet has discovered, that it may also be obtained, by treating muscular flesh, or the fibrous part of the blood, after having washed it well, with nitric acid, in an apparatus suitable for collecting and preserving gases : but these animal matters, when used for this purpose, must be perfectly fresh : if altered, they afford, together with the azotic gas, a mixture of carbonic acid. I myself have discovered, that the air-bladder of the carp, which Dr Priestly had before observed to contain noxious air, is full of this fluid, which may be obtained simply by bursting them under bell-glasses filled with water.

Azotic gas is lighter than atmospheric air. It instantly extinguishes burning tapers ; and acts, with great rapidity and energy, in destroying the life of animals immersed into it. When mixed with vital air, in the proportion of 73 to 27, it affords factitious atmospheric air : in a larger proportion, it forms an air noxious to animals. Neither water, nor earths, nor acids, are known to act upon this gas : It appears, however, that it is liable to be absorbed by the nitric acid, which renders it ruddy. Mr Cavendish has discovered, that three parts of azotic gas, mixed in glasses with seven parts of vital air, and exposed to the action of the electric spark, are by degrees condensed, so as to form the nitric acid : Hence the theory of the formation of this acid in the atmosphere. M. Berthollet has found, that ammoniac is decomposed by hot nitric acid, by oxygenated muriatic acid, and by the detonation of fulminating gold. He has discovered,
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that ammoniac consists of five parts by weight of azote, and one of hydrogen. He has farther discovered, that animal matters contain a great deal of azote, that the ammoniac obtained from them by the action of fire and putrefaction, is formed by the union of that azote with hydrogen,—and that plants, which afford this same salt by distillation, afford it in consequence of their containing azote, and therefore well deserve the name of *animal plants*, which has been given them by some chemists. I have since satisfied myself by experiment, 1. That of all animal matters, the fibrous part affords the most azotic gas by nitric acid; 2. That after putrefaction, it contains no more azote, but affords then a considerable quantity of ammoniac. 3. That several vegetable matters, in particular the gluten of farina, elastic gum, green fecula, and ligneous matter, furnish azotic gas by the action of the nitric acid.

These remarkable qualities of azotic gas, are particularly worthy the attention of the physician. They contribute to explain the difference between animal and vegetable matters, the formation of ammoniac, putrefaction, and the production of the nitric acid from putrid animal matters.

As this elastic fluid has been by some people confounded with carbonic acid, it is to be remembered, that azotic gas has no sensible taste,—is much lighter than that æriform acid, and neither reddens tincture of turnsole, nor precipitates lime-water.

IV. *Nitrous gas* was in some measure known to Hales; but Dr Priestley is properly the discoverer of it. This
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elastic fluid is disengaged from nitric acid by the action of a great number of combustible bodies, especially metals, oils, mucilages, and alcohol. It extinguishes lights; it destroy animals; it is neither acid nor alkaline; it is not liable to be altered by pure water. By combination with vital air, it affords nitric acid; being itself nothing but nitric acid, deprived of a part of its oxigene, and consequently a compound of azote and oxigene,—only, containing more azote and less oxigene than the nitric acid. Hence the varieties of this gas, according as azote and vital air are mixed in it in different proportions; and hence the uncertainty of its effects as an eudiometer. From this we understand, why, in several instances,—especially when, in order to obtain nitrous gas, we use a body very greedy of oxigene, and requiring a considerable quantity of oxigene to saturate it,—the nitrous gas obtained, contains naked azotic gas; and even, sometimes, nothing is obtained but azotic gas. This nitrous gas, which is formed of azote and oxigene, contains a larger proportion of the oxigene than atmospheric air does. Of this a proof is obtained by decomposing it by an alkaline sulphure in solution. A solution of sulphure of potash, when put into a glass filled with nitrous gas, immediately absorbs a part of the gas: In a short time, the gas is no longer reddened by the contact of air, and becomes fit for maintaining combustion, even better than atmospheric air. It is actually converted into air, somewhat purer than the air of the atmosphere, or containing a larger proportion of vital air than atmospheric air usually contains: But if more nitrous gas be added, and the action of the sulphur still continued, the whole of the vital air

is soon absorbed, and what remains is nothing but azotic gas. We may farther observe, that nitrous gas communicates to flame a green colour, before extinguishing it; and that, in many instances this colour is produced by compounds, of which azote forms a part.

These leading properties of nitrous gas, particularly the rapidity of its combination with vital air, shew, that it bears an analogy to combustible bodies; and it has been observed by Macquer, that the artificial formation of nitrous acid by the mixture of these two gases, is a species of combustion; but as it is not accompanied with flame, I have not ventured to rank nitrous gas among the inflammable gases. It differs from atmospheric air in the proportion of its principles, and in their state of compression. In nitrous gas, the oxigene and azote are deprived of all that quantity of caloric and light which they possessed in the atmosphere. The oxigene, however, still retains enough of both these principles to occasion a combustion, with flame, of several combustible bodies, when immersed in it, as pyrophorus, &c.

V. *Carbonic acid gas* was known before any of the other elastic fluids. Dr Black discovered its existence in chalk and alkalis; and at the same time shewed, that it rendered those matters effervescent, mild, and susceptible of crystallization; and that, when deprived of it, alkaline matters become acrid and caustic, and are no longer liable to effervesce, &c. This gas exists in the atmosphere, of which it composes nearly one two-hundredth part; in acidulous waters, and in some subterraneous cavities, such as the *Grotto del Cano*, &c. It is
nearly

nearly twice as heavy as atmospheric air ; its smell is pungent, and its taste acrid ; it extinguishes burning bodies,—kills animals,—reddens tincture of turnsole,—precipitates lime-water,—renders chalk soluble in water,—forms, with all alkaline matters, carbonates, a sort of crystallizable neutral salt, in which the properties of the alkali are still discernible, on account of the weakness of the acid. This acid gas, which acts an important part in the phenomena of nature and art, is a compound of carbone and oxigene ; of carbone, in the proportion of twenty-eight hundred parts,—and oxigene, in the proportion of seventy-two hundredth parts. As carbone, of all known bodies, appears to have the strongest affinity for oxigene, the carbonic acid is among those compounds, of which the decomposition is the most difficult, and one of the products the most frequently obtained in chemical analyses. It is formed in all instances in which bodies containing oxigene are heated with coal ; as in the reduction of metallic oxides by oils,—by coal itself, &c.—by the decomposition of organic matters containing coal and water, &c.

VI. *Sulphureous acid gas* is obtained, either by the slow combustion of sulphure, or by abstracting from sulphuric acid a part of its oxigene ; and is a compound of sulphure with oxigene, containing the latter principle in a more scanty proportion than sulphuric acid. This gas has a sulphureous smell, acrid and pungent, and a very sour taste ; it extinguishes burning bodies, and kills animals : Intense cold condenses it into a liquid state : It reddens and discolours most vegetable blue colours : it combines with water and with ice, and melts the lat-

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ter of these substances by means of the heat which it gives out as it becomes fixed: it absorbs, by degrees oxigene from the atmosphere; and in consequence of that, passes into the state of sulphuric acid.

VII. *Fluoric acid gas* is disengaged from native flu-ate of lime, or *vitreous spar*, by sulphuric acid. Its smell and taste are very strong: it dissolves siliceous earth, and holds it suspended in an æriform invisible state. The contact of water, by fixing it, separates a portion of that earth: Alkalis separate it entirely. The nature of this acid gas is unknown; and if it be like most other mineral acids, a compound, consisting of a simple acidifiable base with oxigene, its acidifiable radical principle must have a very strong affinity with oxigene; for even coal is not able to decompose this gas, by detaching that principle.

VIII. *Muriatic acid gas* is nothing but muriatic acid purified from water, and melted by caloric into an elastic fluid. Its smell, which is lively and suffocating,—its taste, which is very strong,—its solubility in cold water, which readily absorbs it, and separates the heat by which it was maintained in a state of elastic fluidity,—the peculiar neutral salts which it forms with terrene and alkaline bases,—and the white vapour which is observed whenever it comes into contact with water dissolved in the atmosphere,—are its distinguishing characteristics. Its intimate nature, or component principles, are unknown; its acidifiable base has undoubtedly a very strong affinity with oxigene, as these principles have never yet been separated. Nay, we are about

to see, that this acid abstracts oxigene from various other bodies, when they are saturated with it.

IX. *Oxygenated muriatic acid gas* is disengaged with great facility during the reciprocal action of native oxide of manganese and muriatic acid. This peculiar gas is known to be produced by the transition of oxigene from the manganese into the muriatic acid. This gas always retains a colouring part, of a greenish yellow: Its smell is strong and pungent: It is not acid: It weakens and reddens the flame of a taper, but does not extinguish it: It is very quickly fatal to animals: It discolours stuffs, tincture of turnsole, and flowers, rendering them all white: It likewise discolours and whitens yellow wax, &c.: It decomposes ammoniac, which may now be used as a preservative against its noxious effects: the azotic gas of the ammoniac is separated, while the oxigene of the muriatic gas combines with its hydrogen to form water: It condenses fixed oils: It oxidates metals; and even mercury and gold are subject to its influence: It is soluble in water, and communicates to that fluid all its properties: The contact of light by degrees decomposes it, and reduces it into the state of pure muriatic acid.—The formation of oxygenated muriatic acid, and oxygenated muriatic acid gas, is one of the most remarkable discoveries of modern chemistry. This discovery shews, that the relations of muriatic acid to combustible bodies are directly contrary to those of the other acids. All the other acids appear to be decomposable by most of the metals, which have in general a stronger affinity with oxigene than the combustible bases of those acids have. The muriatic acid, on the con-

trary, is not decomposed by any metal : none of them detaches its oxigene ; and in consequence of this, it scarce acts on any of the metals. Its base which is still unknown, is not only intimately connected with the acidifying principle, but even detaches that principle from several other metallic oxides, such as those of mercury, lead, iron, &c. when saturated, it is no longer acid ; as excess of oxigene destroys its acidity. The case is directly contrary with many other combustible bodies. Its excess of oxigene enables it to act upon metals, on which, in its ordinary state, it produces no change ; such particularly, are antimony, silver, and gold. While these metals rob it of this excess of oxigene, they are by degrees burned, and dissolved in the muriatic acid, which returns itself into its original state. These oxidations and solutions of metals, by the oxygenated muriatic acid are accomplished without effervescence, in the same manner as a salt is dissolved in water ; for the metal takes up the superabundant oxigene of the liquid acid quietly, and with much more ease than if it were obliged to disengage it from a combustible base. Oxygenated muriatic acid likewise dissolves metallic oxides, and thereby forms oxygenated muriates, very different in their nature from simple muriates. The most striking and most remarkable of these differences appears in the combinations of the acid, in its different states with oxide of mercury. With oxygenated muriatic acid, oxide of mercury forms *corrosive sublimate*. With simple muriatic acid, the same oxide forms *mild mercury*. The differences between these two salts are therefore owing to the differences between the two states of the acid in respect to the proportions of the
oxigene.

oxigene. The singular properties of the oxigenated muriatic acid render it extremely useful in several of the arts : some of which indeed owe their origin to it, as the bleaching of linen and cotton discovered by M. Berthollet.

X. *Ammoniac gas*, discovered by Dr Priestley, is disengaged by heat from liquid ammoniac, and, with still more rapidity, from a mixture of ammoniacal muriate, or common sal ammoniac, with quick-lime. This elastic fluid, when collected in glasses over mercury, is found to be a little heavier than atmospheric air. The degree of cold or pressure at which it loses its æriform fluidity, is still undetermined. It combines with water, giving out, while the combination takes place, a good deal of heat : it melts ice : it renders syrup of violets, as well as blue and red flowers, green : it combines rapidly with carbonic, sulphureous, and muriatic acid gases ; these combinations produce a good deal of heat : as this heat is disengaged from the two elastic fluids, these become solid while the combinations are forming.

Ammoniac gas is speedily decomposed by the contact of oxigenated muriatic acid gas : the decomposition is accompanied by heat : a quantity of water, charged with muriatic acid, is formed, and there is a residue of azotic gas. This experiment, as well as several others which have been already mentioned, proves ammoniac to consist of hydrogene and azote. The decomposition of ammoniacal copper, and of *fulminating gold* and *silver*, which afford, by the action of fire, water, reduced metal, and azotic gas, is another proof that ammoniac gas consists of these principles ; for, the hydrogene of this

alkali having a stronger affinity for oxigene than either gold or silver, detaches it from the oxides of these metals, and, leaving its azote to be disengaged into a gaseous state, forms water with the oxigene which it has acquired in this manner. The phenomena of this decomposition of ammoniac by oxides are very much diversified—from that which oxide of copper effects slowly, and with the assistance of a strong heat,—to the amazing rapidity with which ammoniacal oxide of silver is reduced, when it detonates by the momentary contact of heat. The diversity of these phenomena is owing to the various affinities of oxigene with the different metals.

Oxides of zinc and iron, which, in their metallic state, decompose water, have not the same power over ammoniac; for these metals have a greater affinity with oxigene, than oxigene has with hydrogene. Hence it is easy to conceive, 1. how ammoniac is produced by the putrefaction of animal substances, and during the decomposition of water and nitric acid by some metals, as tin. 2. How, in opposite circumstances, when ammoniac is decomposed by metallic oxides, the nitric acid comes to be formed.

XI. *Pure hydrogenous gas*, universally known by the name of *inflammable air*, is the lightest of all æriform fluids: When very pure, it is thirteen or fourteen times lighter than atmospheric air. It extinguishes burning bodies: it kills animals: it is kindled by the contact of the electric spark, or of any flaming combustible body: it burns with a bright flame. Fifteen parts of this gas absorb, in burning, eighty-five of vital air; and by that
combustion

combustion, an hundred parts of very pure water are formed—if the elastic fluids be pure. The water is herefore a compound of these two bodies, deprived of most of the heat which is necessary to maintain them in the state of elastic fluidity. All substances having a stronger affinity with any one of these two principles, than that by which their union is maintained, decompose this fluid. Thus, iron, zinc, coal, and oil, decompose water, and separate hydrogene from it into a gaseous state; as they have a stronger affinity with the base of vital air or oxigene than it has with hydrogene. From this it is clear, that hydrogenous gas cannot be expected to decompose carbonic acid, or the oxides of zinc and iron: On the contrary, sulphur, and such metals as do not decompose water, give up the oxigene which they contain, in the state of sulphuric acid, and of metallic oxides, to hydrogenous gas: which reduces the former into the state of pure sulphur, and the latter into the state of metals. This decomposition of water by iron and zinc, is the cause from which proceeds the hydrogenous gas produced during the solution of these two metals by the sulphuric, the muriatic, the carbonic, or the acetous acid.

The leaves of vegetables, on the contrary, appear to possess the property of absorbing the hydrogene of water, and disengaging its oxigene into the state of pure air. Light contributes greatly to this decomposition; and without the contact of light it is never effected. It appears to serve for the purpose of melting oxigene, and thus forming it into vital air; and, while the oxigene is disengaged, the hydrogene becomes fixed in the vegetable, and serves, no doubt, for the produc-

tion of oil. We begin to perceive that hydrogene combines with carbone and a small proportion of oxigene to form the oil of vegetables; and that these again decompose carbonic acid together with water, to absorb the carbone of the first, and the hydrogene of the last of these compounds. Hydrogene, or the base of hydrogenous gas, forms ammoniac, by combination with azote, or the base of azotic gas. M. Berthollet, by analysing that salt, has shewn this to be its composition: But we have not yet been able to form ammoniac by the immediate combination of these two principles.

We have never yet been able to separate the matter of heat combined in hydrogenous gas, to which that gas owes its elastic fluidity, without fixing the hydrogene in some other compound; and therefore, we are still unacquainted with hydrogene in a solitary insulated state. The degree of pressure or cold necessary to effect this separation, must be such as we have not yet learned to apply: Every thing, indeed, concurs to shew, that either the one or the other must be in an extreme degree.

The sudden disengagement, and the rapid inflammation of hydrogenous gas, produce all the fulminations and detonations which are observed in chemistry. The instantaneous recombination of water is almost invariably the consequence of these detonations.

Hydrogenous gas performs an important part in the phenomena of nature. A great quantity of it is produced and disengaged in mines: It there reduces and colours various metallic oxides: it rises in the atmosphere, is carried about by the winds, and kindled by the electric spark: accordingly, it acts the part of thunder; and immediately upon its detonation,

a quantity of water is formed, which streams down upon the earth.

The inflammation of this gas by the electric spark, is one of the most remarkable phenomena in nature, and one of those of which the origin is least known. We are equally at a loss to explain, how the electric spark comes to be capable of fixing a mixture of vital air and azotic gas into nitric acid.

XII. Sulphurated hydrogenous gas, or *hepatic gas*, has been very well distinguished from other hepatic gases by Bergman. It is obtained from solid alkaline sulphures, or *livers of sulphur*, by decomposing them with acids in a pneumatological apparatus. This æri-form fluid has a very fetid smell; it kills animals: it renders syrup of violets green: vital air precipitates sulphur from it; it is kindled by the electric spark, and by the contact of burning bodies: it burns with a reddish blue flame; and, as it burns, deposits sulphur on the sides of the vessels containing it: the ruddy nitrous acid, the sulphureous acid, and the oxygenated muriatic acid decompose it, destroy its elastic fluidity, and separate the sulphur. It combines with water, and the solution is decomposed by the action of air: sulphurated hydrogenous gas colours and reduces oxides of lead, bismuth, &c.; it precipitates solutions of metals. Some metals, particularly mercury and silver, separate the sulphur; accordingly, when passed through glasses containing mercury, a great part of it is decomposed.

All these phenomena agree in shewing, that this gas contains sulphur in a very attenuated state. M. Gengembre, by an analysis, has discovered it to consist of

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hydrogenous gas and sulphur : to the solution or suspension of sulphur, it owes its distinguishing characteristic. The sulphur, however much attenuated, does not burn at the same time with the hydrogenous gas, but is in part deposited during the combustion of the gas : The cause of this phenomenon is, that hydrogenous gas does not need combustion of so high a temperature as sulphur.

It is sulphurated hydrogenous gas which mineralises sulphureous waters. On this account, the common acids never precipitate sulphur from those waters ; but the nitrous acid, the sulphureous acid, and the oxygenated muriatic acid, in which the oxygen is not very intimately combined with the acidifiable base, separate the sulphur by absorbing the hydrogen. If too much of any of these acids be employed, especially of the oxygenated muriatic acid, the sulphur of this gas will be burned, and converted into sulphuric acid ; and then no precipitate will appear.

Our acquaintance with sulphurated hydrogenous gas enables us to explain several things concerning sulphur, which we were before unable to account for. 1. We know now, why solid sulphures, recently prepared, are without smell ; and what occasions their becoming so strongly fetid, when moistened : 2. It appears that water, though not decomposable by sulphur alone, is easily decomposed by the joint action of sulphur and alkaline matters : 3. We understand fully, how alkaline sulphures come to be decomposed by the air, and by several metallic oxides, especially by the oxides of metals which do not decompose water : 4. The theory of sulphureous mineral waters is now easy to explain ; as well as the history of their decomposition by air and metallic oxides ; and the difficulties which were formerly found

in all attempts to detect the sulphur by simple acids, while it was not suspected to exist in those waters in any other state but sulphure or *bepar*.

XIII. *Phosphorated hydrogenous gas* was discovered by M. Gengembre, who called it at the first, *phosphoric gas*. He obtained it, by boiling a lixivium of caustic potash with half its weight of phosphorus, and receiving the elastic fluid that was disengaged, into glasses containing mercury. It kindles by the mere contact of air, producing as it takes fire, a faint explosion. The solid phosphoric acid which it affords, forms, when burning, a sort of *corona* in the air, when not agitated; and towards its extremity, the diameter of the flame does not diminish, but is enlarged. When mixed with vital air under glasses, it burns with the greatest rapidity, and produces such heat and dilatation that the glasses burst if they be not very thick, or if the proportions of the mixture be too large. M. Gengembre has shown, that this new gas is a solution of phosphorus and hydrogenous gas. It bears a considerable resemblance to sulphurated hydrogenous gas; and differs from it in nothing but the nature of the combustible body suspended in the hydrogenous gas. As phosphorus is much more combustible than sulphur, phosphoric hydrogenous gas kindles in the air: the phosphorus is first kindled, and communicates the inflammation to the hydrogenous gas, which is heated by its combustion. In sulphurated hydrogenous gas, on the contrary, the hydrogenous gas is kindled only by the contact of some burning body; and the sulphur not being sufficiently heated, is separated unburnt.

XIV. *Hydrogenous gas*, mixed with azotic gas, forms
that

that elastic fluid which M. Volta has denominated *inflammable air of marshes*. It is produced by the putrefaction of some vegetable matters, and of all animal substances. It is disengaged from waters in marshes, ponds, houses of office, and all places where there are animal matters putrefying in water. It either accompanies, precedes, or follows the formation of ammoniac which takes place in putrefaction. I take it to be a simple mixture of which the component parts are not united by combination; for, were they actually combined, the result would be ammoniac: but it differs from ammoniac, 1. In the elastic state of the two fluids of which it consists; 2. In the proportions of those elastic fluids, which vary in this mixed acid, but in ammoniac are always the same. We are indebted for our present accurate knowledge of this gas to M. Berthollet. In the years 1778 and 1779, I examined the inflammable gas of marshes, and discovered it to contain carbonic acid: but in several of those gases, found in different parts of the neighbourhood of Paris, I found a mixture, the nature of which I did not properly distinguish; although I asserted, as may be seen in the 164th page of the collection of my Memoirs in 8vo, that it is sometimes accompanied, or even has its place supplied by *phlogisticated gas*, which, as I have elsewhere shewn, is the same with what we at present call azotic gas. These were merely vague assertions at the time when I inserted them in my Memoirs: but M. Berthollet has since communicated to them a degree of certainty and precision which induces me to distinguish this gas by the peculiar names above given to it.

Hydrogenous gas, mixed with azotic gas, burns with a blue flame. It detonizes, but not easily, with vital air.

When

When caused to detonize, in M. Volta's eudiometer, it is found to produce some drops of water, and a residue more or less pure.

XV. I distinguish, by the title of *hydrogenous gas* mixed with carbonic acid, that gas which is obtained by distillation from many vegetable matters, particularly from tartar, and all tartareous salts; from acetous salts; from hard wood; from charcoal burning with the help of water; from mineral coal, &c.

It does not burn very readily; but it is not absolutely incombustible, even though three fourths of its bulk be carbonic acid. This acid is separated from it, and the hydrogenous gas purified by lime-water and caustic alkalis. It is a simple mixture, without combination. Hydrogenous gas is not capable of decomposing carbonic acid; for coal decomposes water, having a stronger affinity than hydrogen for its oxygen.

XVI. *Lastly*, It is now known that coal, though very much fixed in close vessels, and in our common fires, is liable to be reduced to vapour, and dissolved into elastic fluids, in a very high temperature. Hydrogenous gas acts with more energy than any other substance in dissolving carbone, and maintaining it in suspension; it frequently therefore carries it with it, as it assumes an elastic fluid form. It is this mixed gas that is disengaged, when cast iron and steel are dissolved in sulphureous acid diluted in water. In consequence of the former having absorbed carbonaceous matter in the tops of the furnaces, and the latter in its cementation, it even appears that coal may be directly dissolved in hydrogenous gas,

by

by directing the rays of the sun from the focus of a mirror, through the middle of a glass filled with this gas, upon coal placed on mercury in the bottom of the glass. This fluid burns with a blue flame; and gives out during its combustion, small white or reddish sparks. The existence of coal in solution in this gas, appears from its gravity, and from its combustion in vital air, which produces carbonic acid. It likewise appears, that coal communicates to hydrogenous gas its well-known fetid smell, or at least it renders that smell stronger. Lastly, coal modifies the effects of this gas, and changes the results of its combinations. Thus, a mixed gas, formed by the solution of coal in azotic gas, seems to be the colouring matter of Prussian blue. But we are not yet acquainted with all the compounds into which coal enters: and the same is to be said of the various mixtures of all the gases with one another, which certainly take place in a great many instances, but of which chemistry has not yet estimated the effects.

Of the Application of the Facts which have been collected, concerning the Nature and Properties of Elastic Fluids, to the great Chemical Phenomena produced by Nature and Art.

It is now acknowledged as an unquestionable fact, that there is perhaps not a single phenomenon in chemistry in which some elastic fluid is not either disengaged or fixed; nay, sometimes both the disengagement and fixation of elastic fluids take place on the same occasion: and the discoveries of the moderns have proved, that the manner in which such phenomena were formerly accounted

counted for, neither explained the causes, nor gave a just view of the effects. The perspicuity which these discoveries have introduced into this part of the science, is a sufficient proof of their importance.

On comparing the numerous facts which constitute the present system of chemical knowledge, it appears that they may be reduced to a few general classes, containing them all under distinct heads. Such an arrangement is the more necessary, as it shows the connections and mutual relations of those facts; and must form, of consequence, the elements of the science of chemistry. But this last object cannot be attained, till all the general phenomena be explained: and as we are still unable to account for a number of these, as I am about to show, this method of laying down the elements of chemistry is to be considered in no other light than as a proposal, the importance and utility of which render it worthy the attention of philosophers.

It is with a view to contribute in part to the carrying of this project into execution, or at least to show that it is not impossible, that I have attempted to reduce all the facts, and the whole theory of chemistry, under fourteen leading phenomena, comprehending the various changes which natural bodies are liable to suffer from the action of the chemical affinities. In order to proceed regularly from simple to compound, in explaining these phenomena, I arrange them in the following order:

1. The absorption or disengagement of caloric, and the production or diminution of heat, with the effects of both.

2. The

2. The influence of air on combustion, and the general nature of combustible bodies.
3. The effects produced by light on bodies.
4. The decomposition and the recomposition of water.
5. The production and the decomposition of earths.
6. The formation and the decomposition of alkalis.
7. Acidification; the formation and decomposition of acids; the nature of these salts, their differences, their analogies, their action on most bodies, &c.
8. The combinations of acids with earths and alkalis.
9. The oxidation and the reduction of metals.
10. The solution of metals by acids.
11. The formation of the immediate principles of vegetables by vegetation.
12. The several sorts of fermentation.
13. The formation of animal matters by the life of animals.
14. The decomposition and putrefaction of animal matters.

Let us briefly consider each of these phenomena, and explain their essential relation to the properties of elastic fluids.

I. *The production of heat* or disengagement of caloric, is owing either to the force of pressure, which disengages it from bodies in which it is contained,—or to combination, which disengages it in like manner. It is to be observed, that this phenomenon takes place more especially when an elastic fluid is fixed in any body; because, as we have already seen, the æriform state of any substance supposes the presence of a good deal of combined

combined heat. It is also to be observed, that as every different body contains a different quantity of heat, or, in other words, different bodies have different capacities of heat,—therefore pressure or combination must produce, from different bodies, very different quantities of this substance. For which reason, this phenomenon, which accompanies a great part of the operations of chemistry, should be observed and estimated with the utmost care, in experiments in which accuracy is intended. Similar to this, is the manner in which the apparent destruction of heat or *absorption of caloric* takes place, which is likewise very often observed in chemical processes. It always depends on the increase of the bulk of bodies, and on their then acquiring a greater capacity for the reception of caloric. Both of these phenomena, therefore, may be estimated mechanically, or merely by observing how the particles of bodies are compressed together, or removed from each other. But in order to form a more just idea of it, we must add to this mechanical cause, the consideration of the particular chemical attraction or affinity between heat and the body on which we are observing its operation. The moderns have made a great many discoveries respecting the influence of caloric in combinations and decompositions.

II. Combustion is one of the most important phenomena in nature. We may distinguish two distinct classes of combustions,—those which take place in the air, and those which take place apparently without the contact of vital air, but on substances containing its base.

Combustions

Combustions effected by the contact of air, are, as has been already said, combinations of the combustible body with the base of vital air or oxigene. In proportion as these combinations take place, the matter of light and caloric are separated from the oxigene, and appear in the form of sensible heat and light. There are some combustible bodies which disengage these fluids slowly from vital air, and afford only little heat when they burn: others, again, disengage these principles rapidly, and cause them to appear in the form of sparkling light, and glowing heat. By communicating more or less oscillation to this light, they give it different shades of colouring; if, with Euler, we consider different coloured rays of light as being all the same matter, only actuated by different oscillations, similar to the vibrations of sound. In certain combustions effected by air, the combustible bodies have so great an affinity to the base of the elastic fluid, that they attract it with the utmost facility; others require, in order to their combination with oxigene, a temperature sometimes exceedingly high, which appears to promote the attractive influence of the combustible body on that base. This theory accounts for the increase of the weight of a burnt body; the change of its state; the impurity of atmospheric air after combustion,—for the proportion of azotic gas then becomes much larger,—and the diversity of the phenomena, such as flame, heat, and rarefaction, which accompany every species of combustion which is effected in the atmosphere.

The second class of combustions is generally effected in close vessels. It consists in general in the transition of oxigene, either more or less solid, out of a body already
ready

ready burnt, into an unburnt body. It depends upon the different elective attractions of this principle, for different combustible bases. To this class belong, the oxidation of metals by acids,—the reduction of metallic oxides by coal,—the combustion of sulphur, phosphorus, coal, and carbure of iron by nitric acid,—the combustion of hydrogen, the principle of ammoniac, by the oxygenated muriatic acid, &c. &c. In all these instances, oxygen passes out of one body into another; and as it was not melted by heat and light, these combustions generally take place without flame. We may observe, that in these instances of combustion, which may be called *tacit*, the property of combustibility is not lost, but only transferred from the body which absorbs the oxygen to that which loses it. We may likewise add, that as oxygen is more or less solid, that is, more or less destitute of heat and light, in the compounds into which it enters, bodies which detach it may sometimes absorb it in a state more pure and solid than that in which it was contained in those in which it before existed: and the disengagement of heat, and even of light, must then take place. Such is the origin of these two phenomena in detonations by nitre,—in the apparent action of nitric acid on sulphur, coal, phosphorus, the generality of metals, oils, and alcohol.

III. *The effects of light on bodies*, have not been hitherto estimated any other way than by their consequences; their cause has never yet been properly explained. It has been long known to act upon vegetables, to communicate to them colour, and to develop their combustible principles. Scheele observed, that

the rays of the sun coloured nitric acid, muriate of silver, mercurial precipitates, &c. It is at present well known, that all these effects are attended with the disengagement of a more or less considerable quantity of vital air: light, therefore, acts at the same time with heat upon these bodies,—separates their oxigene, melts it, and causes it to pass into the state of elastic fluidity. It is in this manner that it contributes to the decomposition of carbonic acid by the leaves of vegetables. That decomposition is, in truth, owing to a double attraction; 1. The attraction of light and heat for oxigene, which they tend to disengage into vital air, &c.; 2. That with which vegetable matters act upon carbone, the radical principle of this acid. By the same mechanism, light promotes the decomposition of water by the same organs of vegetables, and contributes to the formation of their oleaginous principle. By attending with more care than has been hitherto done, to the action of light upon many natural bodies, some important discoveries may be made, as I pointed out in the year 1780.

IV. *The formation and the decomposition of water,* depend entirely on the affinities of oxigene, which is one of its principles. Zinc, iron, oils, and coal, are already known to possess the property of separating the principles of water, by absorbing its oxigene, and disengaging its other principle, hydrogene, in the form of hydrogenous or inflammable gas. The extreme levity of this gas, accounts for the high temperature requisite to effect this decomposition suddenly. It appears, that the base of this gas, hydrogene, which is commonly either
liquid

liquid or solid, in the two states in which water is commonly found on the surface of the globe, has a very great capacity for containing the matter of heat. It even appears, that this base, though combined with oxigene and water, still possesses this property of absorbing a great deal of heat; and that it is this property which renders aqueous vapour lighter than air; in consequence of which, the mercury sinks in the barometer, when the atmosphere is filled with that vapour. This noble discovery of the nature and the decomposition of water, throws much light on the theories of metallic solutions,—of the oxidation of various metals by moisture,—of the formation of the immediate principles of vegetables,—of spirituous fermentation, and of putrefaction: And we already see, that almost all chemical theories are referable to, and depend upon the affinities of oxigene. It throws also great light on the phenomena of the atmosphere,—the formation of meteors,—the laws which nature observes in the successive changes of organic matters, &c. It is particularly worthy of observation, that such substances as do not singly decompose water, effect this decomposition by the assistance of other bodies. Thus sulphur with alkali, tin with nitric acid, &c. decompose water at low temperatures, by means of complex affinities. Nothing can contribute more to throw light on a great number of the phenomena of nature and the arts, than the knowledge of these pre-disposing affinities, &c.

V. There are still several important *desiderata* with respect to the formation of bodies, which the labours of chemists have not explained. One of these is the *for-*

mation of earths. Naturalists have given their opinions concerning the formation of earths: several of them have considered the conversion of flint into clay, as a fact sufficiently proved; but that notion is nothing but an ingenious hypothesis, not supported by facts. Chemists have not been able to change either siliceous earth into alumine, or alumine into siliceous earth. Nature, perhaps, operates this conversion; but as we are unacquainted with the means which she employs, we should not venture to guess, when not countenanced by direct experiments. To consider barytes, magnesia, and lime, as compounds consisting of siliceous and aluminous earths united with some other bodies, is to advance hypotheses which deserve but very little credit. No chemist has hitherto directed his enquiries to this scope: the necessary *data* are even wanting. The experiments of some moderns on the extraction of pretended metallic reguli, from earths treated with charcoal in a violent heat, have afforded only a fallacious result. It appears to be ascertained that all these reguli are but one and the same substance, phosphure of iron, formed from the earth of bones.

VI. Nearly similar is the state of our knowledge with respect to the formation of fixed alkalis. The modern ideas of the principles of chemistry, lead us to suspect azote as a principle of these salts.—We may perhaps even venture to consider this body, the existence of which in ammoniac has been fully proved by M. Berthollet, as a principle common to fixed alkalis and alkaline earths in general,—in a word, as the *alkaligenous* principle. For instance, there can be no doubt, that the fixed al-

kalia

kalis are partly decomposed in many of the operations of Chemistry : in the distillation of old soaps, and tartareous and acetous neutral salts, they are plainly changed into ammoniac.—This transmutation seems to shew, that fixed alkalis contain azote, which, by attaching itself to the hydrogen of the oil, forms ammoniac.—But these facts have not yet been carefully examined, with respect to the quantities of the fixed alkalis which appear to be decomposed, and that of the ammoniac which is obtained,—nor, what is of no less importance, with respect to the residue produced from the fixed alkalis ; and we cannot hope to establish our theory upon this fact, till its circumstances be more exactly known. But though these were known, we should still have to enquire into the nature of the other principle or principles of fixed alkalis, and in what manner the radical principle of potash differs from that of soda, &c.

VII. *The formation and the decomposition of acids*, is one of the most valuable and best known parts of modern chemistry. We know that they consist all of a base or radical principle, more or less combustible, in combination with oxygen : that the oxygen being the same in them all, is the principle of their acidity ; and that the differences among them are owing to the substances combined with the oxygen ; which differ in each different acid.—We know the bases of the sulphuric, the nitric, the carbonic, the arsenic, and the phosphoric acids : we know them to be sulphur, azote, coal, arsenic, and phosphorus. But the acidifiable bases of the muriatic, the fluoric, and the boracic acids in the

mineral kingdom, remain still undiscovered ; as well as the proportions in which hydrogen and carbone, which seem to form the bases of all the vegetable acids, are united in them.

The decomposition of the acids whose nature is known, is not hard to explain. We know that it must happen, whenever a combustible body, having a stronger affinity with oxygen than oxygen has with the acidifiable base, is applied to any acid : And such is the theory of sulphureous and nitrous acid gases by the decomposition of the sulphuric and nitric acids, &c.

The radicals of acids ought also to be distinguished into simple and compound ; sulphur, phosphorus, carbone, &c. are simple radicals. All the vegetable acids have radicals, that are formed of hydrogen and carbone. These last are not decomposed by combustible bodies, because their radicals have more affinity with oxygen than metallic matters, &c. which are generally employed in this decomposition. Thus, of metallic substances, only the metallic acids are soluble in the vegetable acids.

VIII. *The combination of acids with earths and alkalis*, forms the history of neutral salts, and of the mutual affinities or elective attractions of those different matters. It comprehends the examination of the phenomena which take place when they unite,—the taste which they acquire,—their form, solution, crystallization, alterations by fire and air, and mutual decompositions. It has been treated of at great length in this work.

IX. The oxidation and reduction of metals is also referable to the history of air and oxigene. We know, that what has been called the *calcination* of metals, is a combustion,—that it consists in the union and fixation of the base of vital air or oxigene, in the metal calcined ;—that metallic *calces* are compounds of metals and oxigene, which we call *oxides* ;—that most oxides are reduced only by giving out their oxigene to some other body having a stronger affinity with it ;—that coal, by absorbing oxigene from metallic oxides in this manner, forms with it the carbonic acid, which is disengaged in such abundance during their reduction ;—and that there are some metallic oxides, from which oxigene is separated in the state of vital air, by means of heat and light,—a fact which proves, that this oxigene is combined with different metals, with very different degrees of adhesive force. Thus several metals, heated with metallic oxide, carry off their oxigene, as iron and zinc from the oxide of mercury, tin from the oxide of copper, &c. But two very important particulars in the history of the oxidation of metals, which have been ascertained by modern experiments, and which throw great light on all the phenomena of metallic matters, are, 1. That every different metal absorbs, in order to its saturation, a different quantity of oxigene : 2. That each metal may exist in different states of oxidation,—or, combined with different proportions of oxigene,—from that which merely begins the oxidation of a metal, to that by which it is completely accomplished,—for instance, from fifteen to forty or more parts of oxigene, to the hundred weight of iron.

The attentive examination of this second fact, leads

us to distinguish, in every metallic oxide, several different states in respect to the quantity of oxigene which it contains. Thus, mercury suffers an incipient oxidation, and is changed into a black powder in a number of circumstances, which have been hitherto considered as effecting only an extreme attenuation of the metal : and particularly when triturated or extinguished with fats, mucilages, syrups, &c. Thus, iron, in the state of martial ethiops, is the first oxide of that metal, in respect of the small quantity of oxigene which it contains, and cold water easily reduces the metal into this state : Lastly, copper, beginning to be oxidated, or combined with the smallest possible quantity of oxigene, is brown and reddish ; whereas an oxide of this metal, fully saturated with oxigene, is of a bright green.

This distinction of metallic oxides, according to their different states of oxidation, or according as they contain different quantities of oxigene, and possess different properties, in consequence of their having been more or less burnt, enables us to explain a great many phenomena, of which chemists were formerly able to give no satisfactory account.

X. *The solution of metals* in different acids, the properties of these solutions, and of the salts which they afford, agree very well with the modern theory, and are much better explained by it, than they formerly were. No solution of a metal in an acid can take place, without the metal's being first oxidated.

Metals are oxidated by the sulphuric acid,—either by the acid itself, or by the water in which it is diluted.

In the first of these cases, the acid is decomposed, and a quantity of sulphureous acid gas disengaged ; in the second, the water is decomposed, and hydrogenous gas disengaged. Some metals decompose only the sulphuric acid, without acting upon the water ; such as mercury, lead, &c. ; and to burn these metals, the acid must be concentrated. Metals which act with more energy in decomposing water than in decomposing sulphuric acid, such as zinc and iron, are not so readily oxidated unless the acid be diluted, as it is from the water they must derive the necessary oxigene. What proves the certainty of this last fact is, that the sulphuric acid remains undiminished, none of it being decomposed. From these circumstances it is clear, that much more sulphuric acid must be necessary for the solution of a metal which decomposes the acid, than for the solution of a metal which decomposes the water combined with it. In the former case, two different sums of the acid are requisite, one to oxidate the metal, and another to dissolve the metallic oxide : if only the first sum were mixed with the metal, it would only be oxidated, and the second sum of acid would still be necessary to dissolve the oxide : in the laboratories, there is frequently occasion to make such an addition. Accurate observation has shown, that metallic oxides ought to be always in the same degree of oxidation or combination with oxigene, in order that they may be dissolved in the sulphuric acid ; and that when they are fully saturated with the acid, they no longer combine with it. Before this period, they are not soluble in it ; beyond it they are precipitated,—an event which happens when a sulphuric solution is exposed to too strong a heat, or left for a longer or shorter

time exposed to the air. In the first of these operations, the heat promotes the action of the metallic oxide upon the acid; and it of consequence takes up more oxygen than it contained or needed in order to remain suspended in the acid; in the second instance, it absorbs that principle from the atmosphere, till acquiring more than is necessary to its suspension, the oxide is precipitated. Such is the theory of sulphuric mother-waters. Solutions of metals by this acid afford crystals only in the former case. All these facts agree in shewing, that the metals act first upon their solvents; and that the sulphuric acid does not act upon them till they be oxidated to a certain degree.

Nitric acid is likewise decomposed by most metals. They are oxidated or *calcined* to a certain degree by absorbing its oxygen, with which they have a greater affinity than azote. But as they do not take up all the oxygen of the nitric acid,—not, at least, unless too much of the metal be employed, and the mixture be too much heated,—the azote is separated in combination with a portion of oxygen; and this particular combination constitutes nitrous gas. The nitric acid is more liable to decomposition than any other acid; its two component principles not being very intimately united. For this reason, it has always been considered as the chief solvent; and it is owing to the same circumstance, that water is seldom decomposed during the mutual action of metals and the nitric acid, and that a large quantity of water puts a stop to this re-action. Accordingly, solutions of metals in the nitric acid afford only one sort of elastic fluid, nitrous gas, which is sometimes mixed with a little gas azote, especially if the metals employed have a very strong
affinity

affinity with oxigene, and absorb a great deal of it:

Metals which are soluble in the nitric acid combine, and remain in combination with it, only when containing a certain quantity of oxigene not equal to their saturation. Many metallic oxides, therefore, such as those of bismuth, antimony, mercury, tin, and iron, are very easily separated from nitric acid, solely by rest, by heat, or by exposure to the air. As they continue to absorb oxigene from the acid in which they are dissolved, or from the surrounding atmosphere, the quantity of nitric acid must also be very large; that it may be sufficient, first, to oxidate the metal,—secondly, to dissolve the oxide. If you employ only what is requisite for the former purpose, you obtain only a dry oxide; as in the instances of bismuth, zinc, tin, and antimony.

The muriatic acid does not act upon any metal without the assistance of water. Wherefore, as there are but few metals which act upon water, there are but few directly soluble in the muriatic acid; and nothing but hydrogenous gas is ever disengaged, in the case of solution, by this acid. Every thing concurs to show, that the principles of this acid adhere more obstinately together, than those of any other acid; and from this I am much inclined to think, than the unknown base of the muriatic acid, whatever it be, is the body which has the greatest possible affinity with oxigene. None of the combustible bodies which detach that principle from the other substances that contain it, takes it from this acid: but when metallic oxides are once formed, it dissolves them very readily; it even detaches them from several other acids; and it dissolves them even when fully saturated

rated with oxigene; which the other acids are not capable to do. The two last of these properties, which are very remarkable, certainly depend on the tendency which the muriatic acid has to absorb an excess of oxigene; a tendency so fully proved by the formation of the oxigenated muriatic acid, &c. When the muriatic acid dissolves metallic oxides that are too much oxidated to be dissolved by the other acids, it begins with carrying off a portion of the oxigene from the oxides, and part of the water being disengaged into oxigenated muriatic acid, the rest dissolves the remainder of the oxide that is less oxidated.

The action of the other acids on metals is not yet sufficiently known, to enable us to explain it so accurately. We shall only remark, that metals cannot decompose the carbonic acid; for coal the radical principle of that acid, has a stronger affinity with oxigene, than oxigene has with metals; as is proved by the decomposition of metallic oxides by the carbonaceous principle.

Lastly, The precipitation of metallic oxides from acids, by other metallic substances, depends entirely on the diversity of the affinities of oxigene with these substances. When copper precipitates oxide of silver, and iron, oxide of copper, in silver and copper; the reason of these phenomena is, that copper has a stronger affinity with oxigene than silver, and iron than copper.

XI. We are only beginning to understand the formation of the immediate principles of vegetables. It was long ago observed, that plants grew very well in pure water; and that all their constituent principles were
formed

formed with water and atmospheric air: From these two sources they derive all their nourishment: From these, their extract, mucilage, oil, coal, acids, colouring parts, &c. are produced. Since the discovery of the different gasses, it has been observed, that they grow very rapidly in air altered and mixed with carbonic acid, as well as in hydrogenous gas. We have already taken notice, that leaves decompose water and carbonic acid. From the former, they absorb hydrogen; and from the second, carbone; disengaging, from both, vital air. They appear, likewise, to absorb azote. These well-known phenomena explain the formation of coal and of oil: for there can be no doubt, that the latter of these principles consists of hydrogen fixed by carbone, if the expression may be used, as it affords a good deal of water during its combustion. But we are still ignorant of the manner in which the colouring principle, the aroma, the fixed alkali, and the glutinous part, are formed; and whence the varieties of the oils, &c. only we venture to foretel, that new experiments on vegetation, in prosecution of these new views, will hereafter explain the nature and the composition of all these different immediate principles.

We are now beginning to understand the formation of vegetable acids, during vegetation, and even by that act. In the history of acids, we have already taken notice, that they appear to be all formed of similar bases: that, by a last analysis, we obtain equally from them all, carbone, hydrogen, and oxygen; and that they seem to differ only in the proportions of the principles, and in the pressure or density of the substances. The
more

more we extend our experiments upon acids, the more probable will this opinion become.

Scheele and M. Crell have found an analogy to exist among several of them. Scheele, who at first thought the oxalic acid and the acid of sugar to be different from each other, was at length convinced, as we have mentioned elsewhere, that there is no difference between these acids, but that they are precisely the same; —1. By extracting the portion of potash which conceals the properties of the oxalic acid in common salt of sorrel, and, by that means, reducing it to pure oxalic acid; 2. By changing acid of sugar into salt or sorrel, by the addition of a little potash.

If to this most important fact in the analysis of vegetables, we add the valuable experiments of M. Crell, who has extracted tartareous acid from alcohol, and has changed tartareous acid into vinegar, and into oxalic acid, and oxalic acid, again, into acetous acid,—we shall see, that the oxalic, the tartareous, and the acetous acids, greatly resemble each other: that they are formed from one base, and differ only in the proportions of the oxigene which they contain. It appears that the tartareous acid contains least of this principle: that the oxalic acid contains a good deal more of it; and that the acetous acid contains still more than either of the other two. I cannot help thinking, that if four vegetable acids, which were at first thought to be essentially different from each other, have been already found to consist of the same base, combined with different proportions of oxigene; future experiments may in like manner discover the same analogy to subsist among others, particularly between the citric and malic acids,
which

which are so often found together in vegetable juices. These assertions are supported by some experiments on the analysis of the quinquina of St Domingo, which are inserted in one of the volumes of the *Annals of Chemistry*.

Lastly, Our present knowledge of the theory of vegetation, already explains to us the influence of manures. M. Parmentier is the first and almost the only natural philosopher that has begun to apply this theory to agriculture, in a memoir which he read to the Agricultural Society of Paris, in June 1791.

XII. Spiritous fermentation,—the simultaneous formation of the carbonic acid and alcohol,—the necessity of water and a saccharine principle to begin that fermentation,—all together afford us reason to think, that it is produced by the decomposition of water. The oxygen of the water combining with the coal, forms carbonic acid, which is disengaged; and the alcohol is formed by the fixation of the hydrogen in the oily base, which, with different quantities of oxygen, forms the tartareous, the oxalic, and the acetous acids. This theory explains fully the reason why alcohol affords so much water in combustion,—why it is changed by mineral acids into oxalic acid, acetous acid, &c. It is true, we do not yet well understand how it passes into the state of æther; only it is probable that, in such operations, the alcohol loses a portion of its oxygen, which goes to the formation of water.

XIII. Chemists are beginning to conjecture, how far the science can conduct them in their enquiries into the
formation

formation of animal matters. Digestion seems to be simply an extraction or solution by the gastric juice. The fixation of gas azote is one of the principal functions of organization. From the experiments of Scheele, and, still more, from those of M. Berthollet, it appears to occasion the principal difference between animal matters and vegetable substances. It contributes to the formation of the ammoniac which these substances afford in such abundance by distillation, &c. Respiration appears to be one of the most powerful means employed by nature for increasing the quantity of azote in animal substances. The differences among the animal fluids designed for the nourishment of the different organs, and the peculiar nature of the gelatinous humour, of the albuminous liquor, and of the fibrous part, which is melted and dissolved in certain fluids, are now sufficiently ascertained. We know that the former is the least animalised,—that the second is more so,—and that the third is the last substance produced by the action of the vital functions upon the fluids: We know, also, that this last humour is reunited simply by rest into a tissue of solid fibres; and that the albuminous part is thickened, and rendered concrete by heat; whereas the gelatinous substance is sooner decomposed, but also more readily reproduced. Peculiar acids have been found in the excrementitious humours; but we know nothing of their formation: we are particularly ignorant of the manner in which the phosphoric acid, which abounds so generally throughout this kingdom, is formed.

The nature of the solids of animals has engaged the attention of modern chemists. The distinctive nature
of

of the fibrous texture of the muscles,—of the membranous plates,—of the hard laminæ of the bones, &c. is now known. Medicine expects from the discoveries of chemistry, a solution of the problems which still subsist concerning the formation of the several matters which constitute these parts; especially the phosphoric acid, the albuminous juice, the fibrous matter, calcareous phosphate, and the peculiar oils which are found in this kingdom of nature. The formation of ammoniac, which was guessed at by Bergman and Scheele, and has been since fully explained by M. Berthollet, affords us reason for thinking, that all these problems may be successively solved. In all probability, we want only a few principal facts, to enable us to reach several important results: The hope of this must encourage those physicians who know the importance of chemistry.

XIV. Ever since the days of Chancellor Bacon, the history of putrefaction has been acknowledged as an important object in medical enquiries. Several eminent naturalists have studied it with some success: But the cause of this decomposition, and the manner in which it is effected, have not been yet discovered. The late discoveries throw some light on this important point. Water, which promotes and excites putrefaction, is understood to be decomposed in that intestine motion. We understand how ammoniac is formed in such abundance,—by the fixation of azotic gas and hydrogenous gas. The slow decomposition of grease, its preservation and condensation, of which the last in some instances proceeds to solidity and hardness in consequence of the fixation of vital air from water, are now accounted for: In like

manner have been explained, the volatilization and reduction of animal substances exposed to the air into elastic fluids; in a word, the complete separation of all those principles, and their dispersion in the atmosphere, which conveys them into new combinations; with that whole series of compositions, and transitions of substances out of one kingdom into another,—so happily expressed by Beccher under the philosophical emblem, *circulus æterni motus*, which he uses to signify the indefatigable activity of nature.

EXPLA.

EXPLANATION

OF THE

TABLE OF THE NOMENCLATURE.

WE shall begin with observing, that it was not our intention to exhibit, in this Table, the whole of the chemical nomenclature : Our design was only to arrange together, under several classes of compounds, such a number of select examples as might enable any person, with a little study, to apply the principles of our system of nomenclature to all the compounds with which chemists are at present acquainted, as well as to those which may be hereafter discovered. For this purpose, we have divided the table into six perpendicular columns, with the general titles at their heads, expressing the state of the bodies whose names they contain. Each of these columns consists of 55 divisions,—that being the number of the undecomposed substances with which we are acquainted, and which succeed in order in the first column. The correspondent horizontal divisions of the other five columns, comprehend the principal combinations of those simple substances, and must of consequence be equally numerous.

We shall trace each of these columns through its principal divisions.

T 2

C O L U M N

C O L U M N I.

The title of the first column is SUBSTANCES THAT HAVE NOT YET BEEN DECOMPOSED. The reason why we consider these bodies as simple, is, that we have not yet been able to analyse them. All the accurate experiments which have been performed during these last ten years, concur to shew, that these bodies can neither be separated into more simple substances, nor reproduced by artificial combinations. These substances are, as we have already mentioned, 55 in number. They, with their corresponding compounds are numbered with Arabic numerals, running down both the right and left sides of the table.

The 55 simple substances of the first column are divided into five classes, according to the differences of their nature. The first of these classes consists of four bodies, which appear to come nearly under the character that has been assigned to the elements, and act the most important part in combinations. These are, 1. *Light*: 2. *Caloric*, which has hitherto been named matter of heat: 3. *Oxigene*, or that part of vital air which becomes fixed in burning bodies, augments their weight, and changes their nature, and of which the most eminent property being to constitute acids, has induced us to give it a name alluding to that remarkable characteristic: 4. *Hydrogene*, or the base of the elastic fluid which is called Inflammable Gas, and which, as it is one of the principles of water, exists in ice, in a solid state. These first four principal bodies are connected by a brace.

The second class of the undecomposed substances, in
the

the first column, consists of 26 different bodies,—all of which are liable to become acid, by combining with oxygen; and in consequence of their possessing this characteristic in common, we distinguish them by the name of *acidifiable bases*. There are only four of these 26 bodies that can be obtained in a simple uncombined state. These four are, *azote*,—the *radical principle* of the nitric acid *, or the solid base of atmospheric mephitis, well known at present to chemists, in the fifth division; *pure coal, carbon*, or the *radical principle* of the carbonic acid, in the sixth division; *sulphur*, or the *radical principle* of the sulphuric acid, in the seventh division; and *phosphore*, or the *radical principle* of the phosphoric acid, in the eighth division. The other 22 are only known as they exist in combination with oxygen, and in the state of acids. But in order to extend and simplify the Science, we have supposed them separated from oxygen, and existing in that pure state to which it is probable they may one day or other be reduced by art. They are all, therefore, inserted in the first column, as existing in this supposed simple state, and distinguished as the radical principles of the acids into which they enter.

The third class of the undecomposed substances of the first column, consists of metallie matters, in number 17, extending from the 31st to the 47th division, *inclusive*. They all retain the names by which they have been hitherto known. The three first are liable to pass

T 2

into

* It is also to be observed, that azote is never obtained in a separate insulated state, but always in a gaseous state, and in combination with caloric.

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into an acid state,—agreeing, in this characteristic, with the preceding acidifiable bases.

In the fourth class, are the earths which have not yet been decomposed,—*siliceous earth, aluminous earth, barytes, lime, and magnesia*, in so many successive divisions. None of these five earths has yet been decomposed; and they are therefore to be considered, in the present state of our knowledge, as so many simple bodies.

Lastly, the fifth class of undecomposed substances, consists of the three alkalis,—*potash, soda, and ammoniac*. The last of these substances has been decomposed by Messrs Bergman and Scheele; and M. Berthollet has determined, in a precise manner, the nature and the quantity of its principles: But we were unwilling to separate it from the fixed alkalis, the component principles of which we hope also to discover in a short time: It would be improper to break through the order, and overlook the mutual relations of those substances, which in many respects act, in chemical experiments, as undecomposable matters.

The first column, all the divisions of which we have now explained, is, like each of the others, divided longitudinally into two; the left side exhibits the old names of the substances in Italic characters.

COLUMN II.

The second column is intitled, THE SAME SUBSTANCES REDUCED INTO THE STATE OF GAS, BY THE ADDITION OF CALORIC. It exhibits the permanent æiform states into which a number of the simple substances

stances in the first column are liable to pass. In this column, there are only four elastic fluids, the names of which, like all the words in the other columns, are derived from the names of the undecomposable matters, and are rendered sufficiently intelligible, by the addition of the word *gas* to the correspondent words in the first column:—*Oxygenous gas, hydrogenous gas, gas azote, and ammoniacal gas.*

C O L U M N III.

The title of the third column informs the reader, that it consists of THE SAME SUBSTANCES which appear in the first column, COMBINED WITH OXIGENE. This is one of the fullest columns in the Table; for, almost all the bodies in the first column are capable of combination with oxigene. The names in it are all compounded of two words, expressive of the two matters of which the substances to which they belong, consist. The first of these words, is the generic term of the acid, which indicates the saline character that it derives from oxigene: The second peculiarises each acid, and refers to its peculiar radical principle. The 5th division of this third column exhibits the combination of *azote, or nitric radical,* with oxigene. From that combination arise three compounds, produced by a diversity in the proportions of the principles: The azote is either united with the least possible quantity of oxigene, and it then forms the *base of nitrous gas*;—or saturated with it, and then it constitutes *nitric acid*;—or united with less than in nitric acid, yet with more than in nitrous gas, and then it forms *nitrous acid*. We

expresses the three different states of this combination simply by varying the termination of the same word. In the same manner, the termination of the *sulphuric acid* is varied in the 7th division; that of the *phosphoric acid*, in the 8th division; and that of the *acetic acid*, in the 13th. These acids exist in two states of combination with oxygen, according to the quantities which their acidifiable bases contain. When the bases are completely saturated, the acids produced are, the *sulphuric*, the *acetic*, and the *phosphoric*: When the bases are not saturated, and do not contain oxygen in a due proportion, we call the acids that are then formed, the *sulphureous*, the *acetous*, and the *phosphorous*. We have followed the same general rule in the denomination of all the other acids. When an acid is known only in one state, and, in that state, the base is fully saturated with oxygen, such as the carbonic or the boracic acid, its name then terminates in *ic*: when it is known in two states, it is distinguished, in the stronger state, by the termination *ic*; in the weaker, or that in which there is an excess of the acidifiable base, its name terminates in *ous*. Accordingly, in those acids which are known only in one state, and yet have their names terminating in *ous*, it may be understood that there is an excess of the acidifiable base: such are, the *tartareous acid*, in the 14th division; *pyro-tartareous*, in the 15th; the *pyro-ligneous*, in the 21st; and the *pyro-mucous*, in the 22d. The *muriatic acid*, in the 9th division, is in a state different from any of the others. Beside its combination, in which it is saturated with oxygen, it is also capable of receiving an excess of oxygen, which communicates

nicates to it some remarkable properties. To distinguish it as it exists in this last state, we call it the *oxygenated muriatic acid*; and the epithet *oxygenated*, may be in like manner applied to any of the other acids that shall be found existing in the same state. The lower divisions of this third column, from the 31st to the 47th *inclusive*, exhibit the nomenclature of another system of bodies.

The word *oxide* is there found at the beginning of the compound denomination. The reason which induced us to substitute this name to that of metallic calces, has been explained in our memoir on this nomenclature. It does not express a saline quality, as the word *acid* does, and yet denotes a combination of oxigene: and it may be applied to all bodies that are susceptible of a combination with oxigene without passing into a state of acidity; and this, whether their not becoming acid be owing to the scanty proportion of the oxigene, or to the nature of their bases. Thus, for instance, the phosphoric acid, vitrified, or deprived of a part of its oxigene, by the action of a strong heat, becomes a sort of *phosphoric oxide*. Nitrous gas, too, which is not more acid than phosphoric glass, is properly a *nitrous oxide*; and hydrogen, in combination with oxigene, forms not an acid, but water, which, in this light, may be considered as an *oxide of hydrogen*.

Of the 17 metallic oxides, between the 31st and the 48th division, there are 3 which are only in intermediate states between the metallic and the acid. It is for want of oxigene that the oxides of arsenic, molybdena, and tungsten, in the 31st, the 32d, and the 33d divisions, are not yet become acid. A greater quantity of the acidifying principle constitutes them the *arsenic*, the *molybdic*,
and

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and the *tungstic* acids. Epithets taken from colour serve to distinguish the different oxides of the same metal, as may be observed of the oxides of antimony, lead, and mercury.

COLUMN IV.

THE 4th column, intituled, **THE SAME SUBSTANCES IN A GAZEOUS OXIGENATED STATE**, contains simple substances combined both with oxigene and with a sufficient quantity of caloric to reduce them to permanent gases; under the usual pressure and temperature of the atmosphere. There are only six substances known to exist in this state,—*nitrous gas*, *nitrous acid gas*, *carbonic acid gas*, *sulphureous gas*, *muratic* and *oxigenated muratic acid gas*, and *fluoric acid gas*.—No other oxigenated substance having been reduced into a gaseous state by caloric, we have therefore introduced into this column some peculiar combinations of metallic oxides, or oxigenated metals, with different bases: It is accordingly divided in the middle; and the lower part intituled, **METALLIC OXIDES WITH DIFFERENT BASES**.—From the 31st to the 45th division *inclusive*, are the combinations of metallic oxides with sulphur and alkalis. The former are called *sulphurated oxides* of arsenic, lead, &c.; the latter, *alkaline metallic oxides*. When any of these compounds varies in the proportions, and consequently in its properties, we distinguish it in the same manner as the simple oxides, by epithets taken from colour: thus we say, *grey*, *red*, *orange*, &c. *sulphurated oxides of antimony*.

COLUMN

C O L U M N V.

THE 5th column, consisting of the simple SUBSTANCES, in the 1st column, OXIGENATED AND NEUTRALISED BY THE ADDITION OF BASES, OR, neutral salts in general, exhibits many more names than any of the preceding columns ; because we have thought it necessary to give, in this column, a greater number of examples, in order to show the superiority of this system of nomenclature over the ancient names ; most of which, though expressing similar combinations, were in nowise analogical.

Any person may see, by looking slightly over this column, that the names contained in it, and expressing similar combinations, have all one termination. It is easy to see, that this must greatly facilitate the study of the science, and contribute greatly to the perspicuity of works of chemistry in which this mode of denomination shall be adopted. The bodies belonging to this column are compounds of three substances,—acidifiable bases, the acidifying principle, or oxigene, and terrene, metallic, or alkaline bases. But we use only two words to express their nature ; for, the first of these being derived from the name of the oxigenous or acid combination, serves to denote that combination ; the other refers solely to the base with which the acid is saturated. The names of all these compounds terminate in *ate*, when they contain acids completely saturated with oxigene : but when the acids are not completely saturated with that principle, the name of the neutral salt then terminates in *ite*. We have given more instances of neutral

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salts formed from those acids which are best known and most used, than of the salts formed with the acids which are less common *.

The names of 18 genera of neutral salts in this table terminate in *ate*. This termination of their name shews, that the acid to which they owe their formation is known only in the state of the complete saturation of its acidifiable base with oxigene : and accordingly, the names of all the acids to which these neutral salts belong, terminate in *ic*, by the rules of our nomenclature, as appears in the 3d column.

The 14th, 15th, 21st, and 22d, divisions, exhibit names of neutral salts, terminating in *ite*. The termination



* The neutral salts are now exceedingly numerous. There are 29 acids known, which, as each of them may be saturated by 4 soluble earths, 3 alkalis, and 14 metallic oxides which are not acidifiable (for it appears, that the acidifiable oxides, such as those of arsenic, molybdena, and tungsten, do not neutralise the mineral acids), form 609 species of compound salts. Add to this, that 5 of these acids, the nitric, the sulphuric, the muriatic, the acetic, and the phosphoric, combine with neutralisable bases in both of their different states; and that a number of acids, such as the sulphureous, the tartareous, the oxalic, and the arsenic, admit of saturation with different quantities of the base, in consequence of which they form what are called *acidula*, of which there are already 8 different species very well known *. With this addition, the number of the neutral salts will amount to 722 species, the names of which may be methodically formed, from the 46 or 48 examples given in this table.

* Such are, *acidulous sulphate of potash*, or vitriolated tartar with an excess of the acid; *tartarites*, or *acidulous oxalates of potash, soda, and ammoniac*, or creams of tartar, and salts of sorrel, artificially prepared with the pure tartareous and oxalic acids combined with a small quantity of the alkaline bases; and the *acidulous arsenic of potash*, or arsenical neutral salt of Macquer.

nation of these salts is meant to indicate, that in the acids from which they are formed, there is an excess of the acidifiable base.

There are other divisions in this column, exhibiting both the terminations *ate* and *ite* : thus, in the 5th column, *nitrate* and *nitrite* ; in the 7th *sulphate*, and *sulphite* ; in the 8th, *phosphate* and *phosphite* ; in the 13th, *acetate* and *acetite*. These terminations shew, that the salts to which they belong owe their formation to acids existing in two different states. *Nitrates*, for instance, are formed by the *nitric* acid, in which the acidifiable base is fully saturated with oxygen ; and *nitrites* again are formed by the *nitrous* acid, in which the base is not completely saturated with the acidifying principle.

In some others of these divisions, there are neutral salts different from any of the above. • Thus, in the 9th division, we have *oxygenated muriate of potash*, the combination of the oxygenated muriatic acid of potash, a salt very different from simple muriate with potash, and which M. Berthollet has discovered to possess the property of detonizing on burning coals. In other divisions in this same column, we have expressed saline combinations in which the acids predominate, by adding to the systematic name of these salts, the epithet *acidulous* : Thus, the 14th division contains *acidulous tartarite of potash* ; and the 16th, *acidulous oxalate of potash*. Lastly, by the expression *superfaturated*, we distinguish those neutral salts in which the base predominates, as may be seen in the 8th division, in which is, *superfaturated phosphate of soda* ; and in the 10th, in which we have borax, or *superfaturated borate of soda*.

By reflecting on the strict etymological method wh

we have observed in affixing these denominations to neutral salts; and considering, that, in the old nomenclature, there appears scarce any analogy between the names of salts of a similar nature; the Reader will perceive the reason of the changes which appear in this column, which are more numerous than those which any of the others exhibits; though there is actually nothing new in it, but the variation of two terminations of names which were before in use.

C O L U M N VI.

The sixth and last column of this table, which comprehends simple substances combined in their natural state, and neither oxygenated nor acidified,—as the title shews, is one of the shortest, and contains but few compounds. The lower divisions, from the 31st to the 48th, contain compounds consisting of different metals, which we suffer to retain the names of *alloys* and *amalgams*, by which they have been hitherto known. Above the 31st division, there are only three which exhibit a new nomenclature, founded on the same principles with the foregoing. The sixth contains *carbure of iron*;—a denomination by which we have distinguished the natural combination of coal and iron, called *plumbago*. The 7th division exhibits metallic sulphures, or natural combinations of sulphur with metals,—alkaline sulphures, or combinations of sulphur with alkalis and sulphurated hydrogenous gas, or the solution of sulphur in hydrogenous gas. Lastly, in the 8th division, we express, by the generic name of *metallic phosphures*, natural compounds of phosphorus with metals: Thus, to the name
syderite,

syderite, we substitute the expression *phosphure of iron*, which plainly signifies the combination of phosphorus with iron : and these three words *carbure*, *sulphure*, and *phosphure*, differing only in the termination from names which are very well known, convey an accurate idea of similar combinations, and distinguish them from all other compounds.

Below these six columns, we have placed a nomenclature of the principal compound bodies that are found in vegetables. In this part of the table, we have merely selected from among the old names, those whose simplicity and plainness render them suitable to our purposes.

Such is the method which we have followed in forming the system of names exhibited in this table. Those who make themselves masters of this table, which may very easily be done, will readily perceive, that we have formed but very few new words, excepting such as were indispensably necessary to denominate substances before unknown, such as the newly-discovered acids. By tracing the order of the substances in the first column, from which all the rest are derived, any person will see, that we use no new words but *oxigene*, *hydrogene*, and *azote*. As to the words *caloric*, *carbone*, *silice*, *ammoniac*, both these and all their derivations are formed by a very slight change from names before well known and much used. It is plain, therefore, that our new nomenclature differs from the old, in nothing but new terminations ; and if these changes render the study easier, and the language of the science more intelligible,—above all, if they enable us to express ourselves with unequivocal precision,—as the trial of this nomenclature that has been
made

made in the course of Lectures on Chemistry delivered in the King's Garden and the Lyceum, affords us reason to hope;—the reformation which we wish to introduce on so simple a method, cannot but be highly favourable to the progress of Chemistry.——The experience of those years, during which period I have now taught this nomenclature, as well as the testimony of all my pupils, have confirmed the hopes which I formerly entertained.

ADVER.

ADVERTISEMENT

CONCERNING THE

TWO TABLES OF SYNONYMOUS NAMES.

TO our general table of the systematic Nomenclature, exhibiting the whole of our system, we have thought proper to add a list of synonyma, containing all the words necessary in denominating chemical preparations. This list of synonyma is given in the form of two vocabularies. In the first of these, are the old names, disposed in alphabetical order; and opposite to them, the correspondent, new, or newly adopted names. This vocabulary not only shews the names which we have given to the different chemical compounds; but persons not very well acquainted with the preparations in general, the old names of which do not at all explain their nature, will find, in the new synonymous words, a sort of definition of the substances to which they are affixed, sufficiently plain and distinct, to enable them to understand their natures.

In the second vocabulary, the order of the new and the old names is directly contrary to that of the first; and we hope it will be found no less useful.

In it, the new names appear in alphabetical order, and opposite to them, are exhibited the corresponding

old names. In this, our object was, to give a complete list of synonymous terms, in order that students might not, in this science, be under the same difficulties as in some others, particularly in Mineralogy and Botany, in which the vast variety of different names given to the same thing, has produced a degree of confusion and obscurity, which the labours of some of the most indefatigable men have not been sufficient to remove.

In this new vocabulary, we shew that the same substance has frequently received eight, ten, or twelve different names; that most of these names bear no relation to the things to which they are affixed;—which indeed could not but happen in a science in which the first writers sought to conceal every thing under a veil of mystery; and in the history of which we cannot trace the several periods at which those who have cultivated it, have attained an accurate knowledge of the different compounds. But, to avoid tediousness and obscurity, we have taken care not to exhibit here, the names anciently given to different substances by the alchemists, which, as they were founded on absurd or chimerical ideas, have happily been forgotten since chemistry has begun to make equal progress with Natural Philosophy.

Each of these tables of synonyma, therefore, has its use. The first may be used as a dictionary in reading books on chemistry, that have been published before this period, as it gives the new name corresponding to every old name which can occur in such works. In this, as well as in the following, we have given only the names of simpler compound bodies, and of chemical preparations. The names of the operations we have not given, as we have made no change upon them. The

second list of synonyma contains more words than the first; for in it, there are a good many compounds, the knowledge of which we owe to late experiments, and which, till within these few years, had no names. It may therefore be considered as being in some degree an inventory of the chemical knowledge which we at present possess.

In both these lists, there are some synonymous words among the new names. We retain them, because some of them are very generally used, and because some choice of expressions with different terminations is necessary to give variety to discourse, and to prevent a disgusting monotony. Thus, for instance, the word expressive of the base of neutral salts, may be either a substantive or an adjective, at the pleasure of the writer. In books on chemistry, there may be some words found that do not appear in our vocabularies; but the nature of the compounds to which they have been applied, is not yet well known; and those who consider to what strict laws we have here subjected ourselves, will readily be sensible, that it would have been impossible for us to give names to combinations but imperfectly known.

We have added some definitions to several general or particular names, either when we have been doubtful of the nature of the compounds to which they belong, or in speaking of bodies but lately discovered. The second table, which exhibits the new names in alphabetical order, with the corresponding old names, gives at the same time a Latin translation of the new names: In making out this translation, we have still adhered to the same rules. Uniformity of termination, and the laws of derivation, are the two principles by which we have been

uniformly directed. Our Nomenclature would have been imperfect, if we had neglected to offer to philosophers of all nations an uniform mode of expressing themselves, which might make them generally understood. As the science improves, such new names as shall become necessary may be added upon the same plan.

E O M P A

COMPARATIVE VIEW
OF
ANCIENT and MODERN NAMES
OF
CHEMICAL SUBSTANCES,
IN ALPHABETICAL ORDER.

Old Names.	New or adopted Names.
A	
<i>ACETATED Ammoniac.</i>	{ Acetite, ammoniacal.
	{ Acetite of ammoniac.
<i>Acetated lime.</i>	{ Acetite, calcarous.
	{ Acetite of lime.
<i>Acetated clay.</i>	{ Acetite, aluminous.
	{ Acetite of alumine.
<i>Acetated copper.</i>	Acetite of copper.
<i>Acetated magnesia.</i>	{ Acetite, magnesian.
	{ Acetite of magnesia.
<i>Acetated lead.</i>	Acetite of lead.
<i>Acetated soda.</i>	Acetite of soda.
<i>Acetated potash.</i>	Acetite of potash.
<i>Acetated zinc.</i>	Acetite of zinc.
<i>Acetated iron.</i>	Acetite of iron.
<i>Acetated mercury.</i>	{ Acetite of mercury.
	{ Acetite, mercurial.

Old Names.	A	New Names.
<i>Acid, acetous.</i>		Acid, acetous.
<i>Acid, aerial.</i>		Acid, carbonic.
<i>Acid, arsenical.</i>		Acid, arsenic.
<i>Acid of benzoïn.</i>		Acid, benzoic.
<i>Acid of borax.</i>		Acid, boracic.
<i>Acid, carbonaceous.</i>		Acid, carbonic.
<i>Acid of citrons.</i>		Acid, citric.
<i>Acid, cretaceous.</i>		Acid, carbonic.
<i>Acid of ants.</i>		Acid, formic.
<i>Acid of apples.</i>		Acid, malic.
<i>Acid, benzoic.</i>		Acid, benzoic.
<i>Acid of salt.</i>		Acid, muriatic.
<i>Acid of sulphur.</i>		Acid, sulphuric.
<i>Acid of amber.</i>		Acid, succinic.
<i>Acid of sugar.</i>		Acid, oxalic.
<i>Acid of tallow.</i>		Acid, sebacic.
<i>Acid of vinegar.</i>		Acid, acetous.
<i>Acid of Wolfram, according to</i>	}	Acid, tungstic.
<i>Messrs D'Elbuyar.</i>		
<i>Acid, fluoric.</i>		Acid, fluoric.
<i>Acid, formicæ.</i>		Acid, formic.
<i>Acid, galactic.</i>		Acid, lactic.
<i>Acid, gallic.</i>		Acid, gallic.
<i>Acid, lignic.</i>		Acid, pyro-ligneous.
<i>Acid, lithiolic.</i>		Acid, lithic.
<i>Acid, malusian.</i>		Acid, malic.
<i>Acid, marine.</i>		Acid, muriatic.
<i>Acid, dephlogisticated marine.</i>		Acid, oxygenated muriatic.
<i>Acid, mephitic.</i>		Acid, carbonic.
<i>Acid, molybdic.</i>		Acid, molybdic.
<i>Acid, white nitrous.</i>		Acid, nitric.
<i>Acid, nitrous without gas.</i>		Acid, nitric.
<i>Acid, dephlogisticated nitrous.</i>		Acid, nitric.
<i>Acid, phlogisticated nitrous.</i>		Acid, nitrous.
<i>Acid, oxaline.</i>		Acid, oxalic.
<i>Acidum perlatum.</i>		Supersaturated phosphate of soda
<i>Acid, dephlogisticated phosphoric.</i>		Acid, phosphoric.
<i>Acid, phlogisticated phosphoric.</i>		Acid, phosphorous.
<i>Acid, saccharine.</i>		Acid, oxalic.
<i>Acid, sacchalaetic.</i>		Acid, saccho-lactic.
<i>Acid, sebaceous.</i>		Acid, sebacic.
<i>Acid, sedative.</i>		Acid, boracic.
<i>Acid, sparry.</i>		Acid, fluoric.

of Chemical Substances.

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Names.	A	New Names
<i>treous.</i>		Acid, sulphureous.
<i>us.</i>		Acid, pyro mucous.
<i>reous.</i>		Acid, tartarcous.
<i>tic.</i>		Acid, tunstic.
<i>lic.</i>		Acid, sulphuric.
<i>sticated vitriolic.</i>		Acid, sulphureous.
<i>gue.</i>		Imaginary principle of Meyer.
		Chemical affinities or attractions.
		Aggregation.
		Aggregates.
<i>ic acid.</i>		Sulphureous acid gas.
<i>us.</i>		Ammoniacal gas.
<i>sticated.</i>		Oxygenous gas, or vital air.
<i>beric.</i>		Atmospheric air.
<i>Scheele's.</i>		Oxygenous gas.
<i>ous.</i>		Carbonic acid gas.
		Carbonic acid gas.
<i>r.</i>		Azotic gas.
<i>umable.</i>		Hydrogenous gas.
<i>our, sinking.</i>		Sulphurated hydrogenous gas.
<i>;</i>		
<i>solid.</i>		Carbonic acid gas.
<i>d.</i>		Gas azote.
		Oxygenous gas.
		{ Universal solvent, the existence of which was supposed by the Alchemists.
<i>Respour.</i>		Potash mixed with oxide of zinc.
<i>Van Helmont.</i>		Carbonate of potash.
<i>general.</i>		Alkalis.
<i>tar. fixed, not caustic.</i>		Carbonate of potash.
<i>stic.</i>		Alkalis.
<i>errescent.</i>		Alkaline carbonates.
<i>tar. fixed, caustic.</i>		Potash.
<i>stable fixed.</i>		Carbonate of potash.
<i>tic marine.</i>		Soda.
<i>ine, not caustic.</i>		Carbonate of soda.
<i>ted mineral.</i>		Carbonate of soda.
<i>tic mineral.</i>		Soda.
<i>errescent mineral.</i>		Carbonate of soda.
<i>sticated.</i>		{ Ferruginous prussiate of potash, not saturated.
<i>stian.</i>		Ferruginous prussiate of potash.
<i>ted vegetable.</i>		Carbonate of

Old Names.	A	New Names.
<i>Alkali, caustic vegetable.</i>		Potash.
<i>Alkali, caustic volatile.</i>		Ammoniac.
<i>Alkali, concrete volatile.</i>		Ammoniacal carbonate.
<i>Alkali, effervescent volatile.</i>		Ammoniacal carbonate.
<i>Alkali, fluor volatile.</i>		Ammoniac.
<i>Alkali, urinous.</i>		Ammoniac.
<i>Alloy of Metals.</i>		Alloy.
<i>Alum.</i>		{ Sulphate of alumine.
		{ Aluminous sulphate.
<i>Alum, marine.</i>		{ Muriate of alumine.
		{ Aluminous muriate.
<i>Alum, nitrous.</i>		{ Nitrate of alumine.
		{ Aluminous nitrate.
<i>Amalgam of silver.</i>		Amalgam of silver.
<i>Amalgam of bismuth.</i>		Amalgam of bismuth.
<i>Amalgam of copper.</i>		Amalgam of copper.
<i>Amalgam of tin.</i>		Amalgam of tin.
<i>Amalgam of gold.</i>		Amalgam of gold.
<i>Amalgam of lead.</i>		Amalgam of lead.
<i>Amalgam of zinc.</i>		Amalgam of zinc.
<i>Amber yellow.</i>		Amber.
<i>Ammoniac, arsenical.</i>		{ Ammoniacal arseniate.
		{ Arseniate of ammoniac.
<i>Ammoniac, cretaceous.</i>		{ Ammoniacal carbonate.
		{ Carbonate of ammoniac.
<i>Ammoniac, nitrous.</i>		{ Ammoniacal nitrate.
		{ Nitrate of ammoniac.
<i>Ammoniac, phosphoric.</i>		{ Ammoniacal phosphate.
		{ Phosphate of ammoniac.
<i>Ammoniac, sparry.</i>		{ Ammoniacal fluuate.
		{ Fluuate of ammoniac.
<i>Ammoniac, tartareous.</i>		{ Ammoniacal tartarite.
		{ Tartarite of ammoniac.
<i>Ammoniac, vitriolic.</i>		{ Ammoniac sulphate.
		{ Sulphate of ammoniac.
<i>Antimony, ore of.</i>		Native sulphure of antimony
<i>Antimony, crude.</i>		Sulphure of antimony.
<i>Antimony, diaphoretic.</i>		White oxide of antimony by n
<i>Aqua stygia.</i>		{ Nitro-muriatic acid by amm
		{ acal muriate.
<i>Aquila alba.</i>		{ Mild sublimated mercurial
		{ riate.
<i>Arcanam duplicatum.</i>		Sulphate of potash.
<i>Arsenic, regulus of.</i>		Arsenic.

Old Names.	A	New Names.
<i>Arsenic, white calx of.</i>		Oxide of arsenic.
<i>Arsenic, red.</i>		Red sulphurated oxide of arsenic.
<i>Arsenate of potash.</i>		Arsenate of potash.
<i>Attractions, elective.</i>		Elective attractions.
<i>Azure of cobalt, or of four fires.</i>		Vitreous oxide of cobalt with siliceous earth.
	B	
<i>Barotes.</i>		Barytes.
<i>Barotes, effervescent.</i>		Carbonate of barytes.
<i>Base of vital air.</i>		Oxygen.
<i>Base of marine salt.</i>		Soda.
<i>Balsams of Bucquet.</i>		Balfams.
See the new Nomenclature.		
<i>Balsam of sulphur.</i>		Sulphure of volatile oil.
<i>Benzoin.</i>		Benzoin.
<i>Benzones.</i>		Benzoates.
<i>Butter of antimony.</i>		Sublimated muriate of antimony.
<i>Butter of arsenic.</i>		Sublimated muriate of arsenic.
<i>Butter of bismuth.</i>		Sublimated muriate of bismuth.
<i>Butter of tin.</i>		Sublimated muriate of tin.
<i>Baume's solid butter of tin.</i>		Concrete muriate of tin.
<i>Butter of zinc.</i>		Sublimated muriate of zinc.
<i>Bezoar mineral.</i>		Oxide of antimony.
<i>Bismuth.</i>		Bismuth.
<i>Bitumens.</i>		Bitumens.
<i>Blende, or false galena.</i>		Sulphure of zinc.
<i>Blue, Berlin.</i>		Prussiate of iron.
<i>Blue, Prussian.</i>		Prussiate of iron.
<i>Borax, ammoniacal.</i>		Ammoniacal borate.
<i>Borax, argillaceous.</i>		{ Aluminous borate.
		{ Borate of alumine.
<i>Borax, crude.</i>		{ Borate of soda, or borate super-
		{ saturated with soda.
<i>Borax, calcareous.</i>		{ Calcareous borate.
		{ Borate of lime.
<i>Borax of antimony.</i>		Borate of antimony.
<i>Borax of cobalt.</i>		Borate of cobalt.
<i>Borax of copper.</i>		Borate of copper.
<i>Borax of zinc.</i>		Borate of zinc.
<i>Borax, magnesian.</i>		{ Magnesian borate.
		{ Borate of magnesia.

Old Names.	C	New Names
<i>Borax, martial.</i>		Borate of iron.
<i>Borax, mercurial.</i>		Borate of mercury.
<i>Borax, ponderous or barotic.</i>	{	Barytic borate.
<i>Borax, vegetable.</i>		Borate of barytes.
		Borate of potash.
<i>Brass, bronze.</i>	{	Alloy of copper and tin, brass, or bronze.

Old Names.	C	New Names
<i>Calculus, urinary.</i>		Lithic acid.
<i>Camelion, mineral.</i>		Oxide of manganese and potash.
<i>Camphor.</i>		Camphor.
<i>Camphorites, (salts.)</i>		Camphorates.
<i>Causiticum.</i>		Imaginary principle of Meyer.
<i>Ceruse.</i>	{	White oxide of lead by acetic acid, mixed with chalk.
	{	White oxide of antimony by precipitation.
<i>Ceruse of antimony.</i>		Carbone.
<i>Coal, pure.</i>		Vitreous oxide of antimony.
<i>Calx of antimony, vitrified.</i>		Metallic oxides.
<i>Calces, metallic.</i>		Red sulphurated oxide of mercury.
<i>Cinnabar.</i>		Citrates.
<i>Citrates, (salts.)</i>		Cobalt.
<i>Cobalt, or cobolt.</i>		Red oxide of iron by sulphuric acid.
<i>Colcothar.</i>		Sulphate of zinc.
<i>Copperas, white.</i>		Sulphate of iron.
<i>Copperas, green.</i>		Sulphate of copper.
<i>Copperas, blue.</i>		Ammoniacal carbonate.
<i>Chalk, ammoniacal.</i>		Barytic carbonate.
<i>Chalk, barotic.</i>		Carbonate of lead.
<i>Chalk of lead.</i>		Carbonate of soda.
<i>Chalk of soda.</i>		Carbonate of zinc.
<i>Chalk of zinc.</i>		Magnesian carbonate.
<i>Chalk, magnesian.</i>	{	Carbonate of magnesia.
		Carbonate of iron.
<i>Chalk, martial.</i>	{	Calcareous carbonate.
	{	Carbonate of lime.
<i>Chalk, or calcareous spar.</i>	{	Argilla, mixture of alumine and silica.
<i>Clay.</i>		Alumine or aluminous.
<i>Clay, pure.</i>		Aluminous carbonate.
<i>Clay, cretaceous.</i>	{	Carbonate of alumine.

Old Names.	D	New Names.
<i>Clay, sparry.</i>	{	Aluminous fluat.
<i>Cream of lime.</i>		Fluat of alumin.
<i>Cream or crystals of tartar.</i>		Calcareous carbonate.
<i>Crystal mineral.</i>		Acidulous tartarite of potash.
<i>Crystals of soda.</i>		Nitrite of potash, mixed with
<i>Crystals of the moon.</i>		sulphate of potash.
<i>Crystals of Venus.</i>		Crystallised carbonate of potash.
<i>Crocus metallorum.</i>		Crystallised nitrate of silver.
<i>Copper.</i>		Crystallised acetite of copper.
<i>Copper, yellow.</i>		Semi-vitreous sulphurate oxide
		of antimony.
		Copper.
	{	Alloy of copper and zinc; or
		latten.

D

Diamond.

Diamond.

E

<i>Emetic.</i>	Antimonial tartarite of potash.
<i>Empyreal air.</i>	Oxygenous gas.
<i>Essences.</i>	Volatile oils.
<i>Ether, acetous.</i>	Acetic æther.
<i>Ether, marine.</i>	Muriatic æther.
<i>Ether, nitrous.</i>	Nitric æther.
<i>Ether, vitriolic.</i>	Sulphuric æther.
<i>Ethiops, martial.</i>	Black oxide of iron.
<i>Ethiops, mineral.</i>	{ Black sulphurated oxide of mer-
<i>Ethiops per se.</i>	cury.
<i>Extract.</i>	Blackish mercurial oxide.
	Extractive principle.

F

<i>Feculum of plants.</i>	Feculum.
<i>Flowers, ammoniacal of copper.</i>	{ Sublimated ammoniacal muriate
	of copper.
<i>Flowers, martial ammoniacal.</i>	{ Sublimated ammoniacal muriate
	of iron.

Old Names.	G	New Names.
<i>Flowers, silver of regulus of antimony.</i>	}	Sublimated oxide of antimony.
<i>Flowers of arsenic.</i>		Sublimated oxide of arsenic.
<i>Flowers of benzoïn.</i>		Sublimated benzoic acid.
<i>Flowers of bismuth.</i>		Sublimated oxide of bismuth.
<i>Flowers of tin.</i>		Sublimated oxide of tin.
<i>Flowers, metallic.</i>		Sublimated metallic oxides.
<i>Flowers of sulphur.</i>		Sublimated sulphur.
<i>Flowers of zinc.</i>		Sublimated oxide of zinc.
<i>Fluids, ærisiform.</i>		Gases.
<i>Fluids, Elastic.</i>		Gases.
<i>Fluor, ammoniacal.</i>	}	Ammoniacal fluat.
	}	Fluat of ammoniac.
<i>Fluor, argillaceous.</i>	}	Aluminous fluat.
	}	Fluat of alumine.
<i>Fluor of potash.</i>		Fluat of potash.
<i>Fluor of soda.</i>		Fluat of soda.
<i>Fluor, magnesian.</i>	}	Magnesian fluat.
	}	Fluat of magnesia.
<i>Fluor, heavy.</i>	}	Barytic fluat.
	}	Fluat of barytes.
<i>Formiates, (salts.)</i>		Formiates.

G

<i>Galaëtes, (salts.)</i>	Laëtates.
<i>Gas, acetous acid.</i>	Acetous acid gas.
<i>Gas, cretaceous acid.</i>	Carbonic acid gas.
<i>Gas, marine acid.</i>	Muriatic acid gas.
<i>Gas, aerated muriatic acid.</i>	Oxygenated muriatic acid gas.
<i>Gas, nitrous acid.</i>	Nitrous acid gas.
<i>Gas, sparry acid.</i>	Fluoric acid gas.
<i>Gas, sulphureous acid.</i>	Sulphureous acid gas.
<i>Gas, alkaline.</i>	Ammoniacal acid gas.
<i>Gas, hepatic.</i>	Sulphurated hydrogenous gas.
<i>Gas, inflammable.</i>	Hydrogenous gas.
<i>Gas, carbonaceous inflammable.</i>	Carbonated hydrogenous gas.
<i>Gas, inflammable, of marshes.</i>	Hydrogenous gas of marshes (a mixture of carbonated hydrogenous gas with azotic gas.)
<i>Gas, mephitic.</i>	Carbonic acid gas.
<i>Gas, phlogisticated.</i>	Gas azote.
<i>Gas, nitrous.</i>	Nitrous gas.

es.	H	New Names.
<i>M. Gengembre.</i>		Phosphorated hydrogenous gas. Prussic acid gas. { Waters impregnated with carbonic acid. Sulphate of zinc. Gluten, or glutinous principle. Gold. Ammoniacal oxide of gold.
	H	Sulphures. Caloric.
	I	
<i>by cobalt.</i>		Muriate of cobalt. Iron. Carbonate of iron. Phosphate of iron. Tin.
	K	
		{ Red sulphurated oxide of antimony.
	L	
		{ Alloy of copper and zinc, or latten. Concrete potash or soda. Carbonate of lime. Solution of soda. Pyro lignites. Alcohol of potash. Siliceous potash in liquor.
<i>makers.</i>		{ Ammoniacal sulphure.
<i>of fus.</i>		{ Sulphure of ammoniac.
<i>fuming.</i>		Fuming muriate of tin.
<i>of Libavius.</i>		

Old Names.	L	New Names.
<i>Litharge.</i>	{	Semi-vitreous oxide of lead, or litharge.
<i>Liquor saturated with the colouring part of Prussian blue.</i>	{	Prussiate of potash.
<i>Light.</i>		Light.
<i>Luna.</i>		Silver.
<i>Luna, corneous.</i>		Muriate of silver.
<i>Liver of antimony.</i>		Sulphurated oxide of antimony.
<i>Liver of arsenic.</i>		Arsenical oxide of potash.
<i>Liver, volatile alkaline of sulphur.</i>	{	Ammoniacal sulphure.
<i>Liver, antimoniated, of sulphur.</i>	{	Sulphure of ammoniac.
<i>Liver, barotic, of sulphur.</i>	{	Antimoniated alkaline sulphure.
<i>Liver, calcareous, of sulphur.</i>	{	Barytic sulphure.
	{	Sulphure of barytes.
	{	Calcareous sulphure.
	{	Sulphure of lime.
<i>Liver, magnesian, of sulphur.</i>	{	Sulphure of magnesia.
	{	Magnesian sulphure.
<i>Livers of sulphur.</i>		Alkaline sulphures.
<i>Livers of sulphur, earthy.</i>		Earthy sulphures.
<i>Lead, or saturn.</i>		Lead.
<i>Lead, corneous.</i>		Muriate of lead.
<i>Lead, spathose.</i>		Carbonate of lead.

M

<i>Magistery of bismuth.</i>		Oxide of bismuth by nitric acid.
<i>Magistery of sulphur.</i>		Precipitated sulphur.
<i>Magistery of lead.</i>		Precipitated oxide of lead.
<i>Magnesia, white.</i>		Carbonate of magnesia.
<i>Magnesia of Bergman, aerated.</i>		Carbonate of magnesia.
<i>Magnesia, caustic.</i>		Magnesia.
<i>Magnesia, cretaceous.</i>		Carbonate of magnesia.
<i>Magnesia, effervescent.</i>		Carbonate of magnesia.
<i>Magnesia, fluorated.</i>		Fluate of magnesia.
<i>Magnesia, black.</i>		Black oxide of manganese.
<i>Magnesia, sparry.</i>		Fluate of magnesia.
<i>Malufites, (salts.)</i>		Malates of potash, soda, &c.
<i>Massicot.</i>		Yellow oxide of lead.
<i>Matter of heat.</i>		Caloric.
<i>Matter of fire.</i>	{	This word has been used to signify light, caloric, and phlogiston.

Old Names.

M

New Names.

<i>Materia perlata of Kerkringius.</i>	{ White oxide of antimony by precipitation.
<i>Mephite, ammoniacal.</i>	{ Ammoniacal carbonate.
	{ Carbonate of ammoniac.
<i>Mephite, barotic.</i>	{ Barytic carbonate.
	{ Carbonate of barytes.
<i>Mephite, calcareous.</i>	{ Calcareous carbonate.
	{ Carbonate of lime.
<i>Milk of lime.</i>	{ Lime diluted in water.
<i>Mephite of magnesia.</i>	{ Magnesian carbonate.
	{ Carbonate of magnesia.
<i>Mephite of lead</i>	{ Carbonate of lead.
<i>Mephite of zinc.</i>	{ Carbonate of zinc.
<i>Mephite, martial.</i>	{ Carbonate of iron.
<i>Matter, colouring, of Prussian blue.</i>	{ Prussic acid.
<i>Mercury.</i>	{ Mercury.
<i>Mercury of metals.</i>	{ Imaginary principle of Beccher.
<i>Mercury, mild.</i>	{ Mild mercurial muriate.
<i>Mercury, white precipitated</i>	{ Mercurial muriate by precipitation.
<i>Minium.</i>	{ Red oxide of lead, or minium.
<i>Mofetes, atmospheric.</i>	{ Azotic gas.
<i>Molybdes, (salts)</i>	{ Molybdates.
<i>Molybde, ammoniacal.</i>	{ Ammoniacal molybdate.
	{ Molybdate of ammoniac.
	{ Barytic molybdate.
<i>Molybde, barotic.</i>	{ Molybdate of barytes.
<i>Molybde of potash.</i>	{ Molybdate of potash.
<i>Molybde of soda.</i>	{ Molybdate of soda.
<i>Molybdena.</i>	{ Molybdena.
<i>Mucilage.</i>	{ Mucilage.
<i>Muriates, (salts)</i>	{ Muriates.
<i>Muriate of antimony.</i>	{ Muriate of antimony.
<i>Muriate of silver.</i>	{ Muriate of silver.
<i>Muriate of bismuth.</i>	{ Muriate of bismuth.
<i>Muriate of cobalt.</i>	{ Muriate of cobalt.
<i>Muriate of copper.</i>	{ Muriate of copper.
<i>Muriate of tin.</i>	{ Muriate of tin.
<i>Muriate of iron.</i>	{ Muriate of iron.
<i>Muriate of manganese.</i>	{ Muriate of manganese.
<i>Muriate of lead.</i>	{ Muriate of lead.
<i>Muriate of zinc.</i>	{ Muriate of zinc.
<i>Muriate, or regaline salt of platina.</i>	{ Nitro muriate of platina.

Old Names.	M	New Names.
<i>Muriate or regaline salt of gold.</i>		Muriate of gold.
<i>Muriate, corrosive mercurial.</i>		Corrosive mercurial muriate.

N

<i>Natrum, or natron.</i>		Carbonate of soda.
<i>Nitre.</i>		Nitrate of potash, or nitre.
<i>Nitre, ammoniacal.</i>		Ammoniacal nitrate.
<i>Nitre, argillaceous.</i>		Nitrate of alumine.
<i>Nitre, calcareous.</i>		{ Calcareous nitrate.
<i>Nitre, cubic.</i>		{ Nitrate of lime.
<i>Nitre of silver.</i>		Nitrate of soda.
<i>Nitre of arsenic.</i>		Nitrate of silver.
<i>Nitre of bismuth.</i>		Nitrate of arsenic.
<i>Nitre of cobalt.</i>		Nitrate of bismuth.
<i>Nitre of copper.</i>		Nitrate of cobalt.
<i>Nitre of tin.</i>		Nitrate of copper.
<i>Nitre of iron.</i>		Nitrate of tin.
<i>Nitre of magnesia.</i>		Nitrate of iron.
<i>Nitre of manganese.</i>		{ Magnesian nitrate.
<i>Nitre of nickel.</i>		{ Nitrate of magnesia.
<i>Nitre of lead.</i>		Nitrate of manganese.
<i>Nitre of terra ponderosa.</i>		Nitrate of nickel.
<i>Nitre of zinc.</i>		Nitrate of lead.
<i>Nitre, fixed, by itself.</i>		{ Barytic nitrate.
<i>Nitre, lunar.</i>		{ Nitrate of barytes.
<i>Nitre, mercurial.</i>		Nitrate of zinc.
<i>Nitre, prismatic.</i>		Carbonate of potash.
<i>Nitre, quadrangular.</i>		Nitrate of silver.
<i>Nitre, rhomboidal.</i>		Nitrate of mercury.
<i>Nitre, saturnine.</i>		Nitrate of potash.
		Nitrate of soda.
		Nitrate of soda.
		Nitrate of lead.

O

<i>Ochre.</i>	Yellow oxide of iron.
<i>Oils, animal.</i>	Volatile animal oil.

Old Names.	O	New Names.
<i>Oil of lime.</i>		Calcareous muriate.
<i>Oil of tartar per deliquium.</i>	{	Potash, mixed with carbonate of potash, in a deliquescent state.
<i>Oil, philosopher's</i>		Empyreumatic fixed oils.
<i>Oil of vitriol.</i>		Sulphuric acid.
<i>Oil of wine, sweet.</i>		Ethereal oil.
<i>Oils, empyreumatic.</i>		Empyreumatic oils.
<i>Oils, ethereal.</i>		Volatile oils.
<i>Oils, fat.</i>		Fixed oils.
<i>Oils, essential.</i>		Volatile oils.
<i>Oils by expression.</i>		Fixed oils.
<i>Ore of antimony.</i>		Native sulphure of antimony.
<i>Ore of iron, from marshes.</i>	{	Iron ore, containing phosphate of iron.
<i>Orpiment.</i>	{	Yellow sulphurated oxide of arsenic.
<i>Oxygene.</i>		Oxygene.

P

<i>Phlogiston.</i>		Imaginary principle of Stahl.
<i>Philosophic wool.</i>		Sublimated oxide of zinc.
<i>Phosphate ammoniacal.</i>	{	Ammoniacal phosphate.
	{	Phosphate of ammoniac.
<i>Phosphate, barotic.</i>	{	Barytic phosphate.
	{	Phosphate of barytes.
<i>Phosphate, calcareous.</i>	{	Calcareous phosphate.
	{	Phosphate of lime.
<i>Phosphate of magnesia.</i>	{	Magnesian phosphate.
	{	Phosphate of magnesia.
<i>Phosphate of potash.</i>		Phosphate of potash.
<i>Phosphate of soda.</i>		Phosphate of soda.
<i>Phosphorus of Baudouin.</i>		Dry calcareous nitrate.
<i>Phosphorus of Kunckel.</i>		Phosphorus.
<i>Phosphorus of Homberg.</i>		Dry calcareous muriate.
<i>Ponderous stone.</i>		Calcareous tunitate.
<i>Platina.</i>		Platina.
<i>Plaster.</i>	{	Calcareous sulphate, or calcined plaster.
<i>Plumbago.</i>		Carbure of iron.
<i>Pompholyx.</i>		Sublimated oxide of zinc.

Old Names.	P	New Names.
<i>Potashes of commerce.</i>		Impure carbonate of potash.
<i>Putty of tin.</i>		Grey oxide of tin.
<i>Powder of Algaroth.</i>	{	Oxide of antimony by muriatic acid.
<i>Powder of Count Palma.</i>	{	Carbonate of magnesia.
<i>Powder of Sentinelly.</i>	{	Mercurial muriate by precipitation.
<i>Precipitate, white, by muriatic acid.</i>	{	Oxide of gold precipitated by tin.
<i>Precipitate of gold by tin, or purple of Cassius.</i>	{	Yellow oxide of mercury by sulphuric acid.
<i>Precipitate, yellow.</i>	{	Red oxide of mercury by fire.
<i>Precipitate per se.</i>	{	Red oxide of mercury by nitric acid.
<i>Precipitate, red.</i>	{	Oxygene.
<i>Principle, acidifying.</i>		Gallic acid.
<i>Principle, astringent.</i>		Carbonic.
<i>Principle, carbonaceous.</i>		
<i>Principle, inflammable.</i>		
(<i>Sec phlogiston.</i>)		
<i>Principle, mercurial.</i>		Imaginary principle of Beccher.
<i>Principium forbile of M. Ludbock.</i>		Oxygene.
<i>Prussite, calcareous.</i>	{	Calcareous prussiate.
<i>Prussite of potash.</i>	{	Prussiate of lime.
<i>Prussite of soda.</i>		Prussiate of potash.
<i>Pyrites of copper.</i>		Prussiate of soda.
<i>Pyrites, martial.</i>		Sulphure of copper.
		Sulphure of iron.
<i>Pyrophorus of Homberg.</i>	{	Carbonated sulphure of alumine.
	{	Pyrophorus of Homberg.

R

<i>Rea'gar, or realgal.</i>		Red sulphurated oxide of arsenic.
<i>Regaltes, (salts formed with aqua regia)</i>	{	Nitro-muriates.
<i>Regia, aqua.</i>		Nitro-muriatic acid.
<i>Regulus.</i>	{	A word used to denote the pure metallic state, in opposition to ores, and oxides.
<i>Regulus of antimony.</i>		Antimony.
<i>Regulus of arsenic.</i>		Arsenic.

Old Names.	R	New Names.
<i>Regulus of cobalt.</i>		Cobalt.
<i>Regulus of manganese.</i>		Manganese.
<i>Regulus of molybdena.</i>		Molybdena.
<i>Regulus of syderite.</i>		Phosphure of iron.
<i>Resins</i>		Resins.
<i>Rust of copper.</i>		Green oxide of copper.
<i>Rust of iron.</i>		Carbonate of iron.
<i>Rubine of antimony.</i>		Sulphurated oxide of antimony.
<i>Red nitrated mercury.</i>	{	Red oxide of mercury by nitric acid.

S

<i>Saffron of mars.</i>		Oxide of iron.
<i>Saffron, aperient, of mars.</i>		Carbonate of iron.
<i>Saffron, astringent, of mars.</i>		Brown oxide of iron.
<i>Saffron of metals.</i>	{	Semi-vitreous sulphurated oxide of antimony.
<i>Saltpetre.</i>		Nitrate of potash, or nitre.
<i>Saturn.</i>		Lead.
<i>Soaps, acid.</i>		Acid soaps.
<i>Soaps, alkaline.</i>		Alkaline soaps.
<i>Soaps, earthy, or oleo-terrene combinations of M. Berthollet.</i>	{	Earthy soaps.
<i>Soaps, metallic, or oleo-metallic combinations of M. Berthollet.</i>	{	Metallic soaps.
<i>Soap of Starkey.</i>		Saponula of potash.
<i>Sebates, (salts.)</i>	{	Sebates.
<i>Salt, ammoniacal acetous.</i>	{	Ammoniacal acetite.
	{	Acetite of ammoniac.
<i>Salt, calcareous acetous.</i>	{	Calcareous acetite.
	{	Acetite of lime.
<i>Salt, acetous of clay.</i>	{	Aluminous acetite.
	{	Acetite of alumine.
<i>Salt, acetous of zinc.</i>	{	Acetite of zinc.
	{	Magnesian acetite.
<i>Salt, magnesian acetous.</i>	{	Acetite of magnesia.
	{	Acetite of iron.
<i>Salt, acetous martial.</i>		Acetite of soda.
<i>Salt, acetous mineral.</i>		Superfaturated phosphate of soda.
<i>Sal admirabile perlatum.</i>		Ammoniaco-mercurial muriate.
<i>Sal Alembroth.</i>		

Old Names.	S	New Names.
<i>Sal ammoniac.</i>		{ Ammoniacal muriate.
<i>Salt, cretaceous ammoniacal.</i>		{ Muriate of ammoniac.
<i>Sal ammoniac, fixed.</i>		{ Ammoniacal carbonate,
		{ Calcareous muriate.
		{ Muriate of lime.
<i>Salt ammoniacal, nitrous.</i>		{ Ammoniacal nitrate.
		{ Nitrate of ammoniac.
<i>Salt ammoniacal, (a secret of Glauber's.)</i>		{ Ammoniacal sulphate.
		{ Sulphate of ammoniac.
<i>Salt, bitter cathartic.</i>		{ Magnesian sulphate.
		{ Sulphate of magnesia,
		{ Ammoniacal borate.
<i>Salt, ammoniacal sedative.</i>		{ Borate of ammoniac.
		{ Ammoniacal fluuate.
<i>Salt, ammoniacal sparry.</i>		{ Fluuate of ammoniac.
		{ Ammoniacal sulphate.
<i>Salt, ammoniacal vitriolic.</i>		{ Sulphate of ammoniac.
<i>Salt, common.</i>		{ Muriate of soda.
<i>Salt, English.</i>		{ Ammoniacal carbonate.
		{ Carbonate of ammoniac.
<i>Salt of colcothar.</i>		{ Sulphate of iron (<i>its particular state not well known.</i>)
<i>Salt, kitchen.</i>		{ Muriate of soda.
<i>Salt, Glauber's.</i>		{ Sulphate of soda,
<i>Salt of Jupiter.</i>		{ Muriate of tin.
<i>Salt of milk.</i>		{ Sugar of milk.
<i>Salt of wisdom.</i>		{ Ammoniaco-mercurial muriate
<i>Salt of Epsom.</i>		{ Magnesian sulphate.
<i>Sal de Duobus.</i>		{ Sulphate of magnesia.
<i>Salt of Scheidschutz.</i>		{ Sulphate of potash.
<i>Salt of Sedlitz.</i>		{ Sulphate of magnesia.
<i>Salt of Segner.</i>		{ Sebate of potash.
<i>Salt of Seignette.</i>		{ Tartarite of soda.
<i>Salt of amber, obtained by crystallization.</i>		{ Crystallised succinic acid.
<i>Salt of sorrel.</i>		{ Acidulous oxalate of potash.
<i>Salt, febrifuge, of Sylvius.</i>		{ Muriate of potash.
<i>Salt, fixed, of tartar.</i>		{ Carbonate of potash not saturated.
<i>Salt, fusible, of urine.</i>		{ Phosphate of soda and ammoniac.
<i>Sal gem.</i>		{ Fossil muriate of soda.

Old Names.	S	New Names.
<i>arine.</i>		Muriate of soda.
<i>rgillaceous marine.</i>	{	Aluminous muriate.
		Muriate of alumine.
<i>votic marine.</i>	{	Barytic muriate.
		Muriate of barytes.
<i>ilcareous marine.</i>	{	Calcareous muriate.
		Muriate of lime.
<i>arine, of iron.</i>		Muriate of iron.
<i>arine, of zinc.</i>		Muriate of zinc.
<i>magnesian marine.</i>	{	Magnesian muriate.
		Muriate of magnesia.
<i>tive, of urine.</i>		Phosphate of soda and ammoniac.
<i>natural arsenical, of Mac-</i>	{	Acidulous arseniate of pot-
		ash.
<i>sugar of saturn.</i>		Acetite of lead.
<i>lycbrest, of Glafer.</i>		Sulphate of potash.
<i>lycbrest, of Rochelle.</i>		Tartarite of soda.
<i>galine, of gold.</i>		Muriate of gold.
<i>idative.</i>		Boracic acid.
<i>idative mercurial.</i>		Borate of mercury.
<i>blimated sedative.</i>		Sublimated boracic acid.
<i>anno-nitrous.</i>		Nitrate of tin.
<i>lphureous, of Stahl.</i>		Sulphate of potash.
<i>vegetable.</i>		Tartarite of potash.
<i>latile, of England.</i>		Ammoniacal carbonate.
<i>latile, of amber.</i>		Sublimated succinic acid.
		Sulphate of lime.
	{	Oxide of cobalt vitrified with si-
		lex, or <i>smalt</i> .
<i>ustic.</i>		Soda.
<i>retaceous.</i>		Carbonate of soda.
<i>atboise.</i>		Fluate of soda.
<i>.</i>		Sulphur.
<i>, gilded, of antimony.</i>	{	Sulphurated, orange, oxide of
		antimony.
<i>ammoniacal.</i>		Ammoniacal fluate.
<i>alcareous.</i>		Carbonate of lime.
<i>luor.</i>		Calcareous fluate.
<i>onderous.</i>		Sulphate of barytes.
<i>syroestris.</i>		Carbonic acid.
<i>antimony.</i>	{	White sublimated oxide of anti-
		mony.

Old Names.	S	New Names.
<i>Spirit, acid, of wood.</i>		Pyro-ligneous acid.
<i>Spirit, volatile alkaline.</i>	{	Gas ammoniac, or ammoniacal gas.
<i>Spirit, ardent, or spirit of wine.</i>		Alcohol.
<i>Spirit of Mendererus.</i>		Ammoniacal acetite.
<i>Spirit of nitre.</i>		Nitric acid diluted in water.
<i>Spirit, fuming, of nitre.</i>		Nitrous acid.
<i>Spirit, dulcified, of nitre.</i>		Nitric alcohol.
<i>Spirit of salt.</i>		Muriatic acid.
<i>Spirit of sal ammoniac.</i>		Ammoniac.
<i>Spirit of wine.</i>		Alcohol.
<i>Spirit of vitriol.</i>		Sulphuric acid diluted in water.
<i>Spirit of Venus.</i>		Acetic acid.
<i>Spiritus rectior.</i>		Aroma.
<i>Spirits, acid.</i>		Acids diluted in water.
<i>Spirit, volatile, of sal ammoniac.</i>		Ammoniac diluted in water.
<i>Sublimate, corrosive.</i>		Corrosive muriate of mercury.
<i>Sublimate, mild.</i>		Mild muriate of mercury.
<i>Lemon, or citron juice.</i>		Citric acid.
<i>Semi-metals.</i>		Semi-metals.
<i>Succinum.</i>		Amber.
<i>Stone, infernal.</i>		Melted nitrate of silver.
<i>Sugar.</i>		Sugar.
<i>Sugar candy.</i>		Crystallised sugar.
<i>Sugar of saturn.</i>		Acetite of lead.
<i>Sugar or salt of milk.</i>		Sugar of milk.
<i>Syderite.</i>		Phosphate of iron.
<i>Stearch.</i>		Stearch.
<i>Syderotete of M. de Morveau.</i>		Phosphure of iron.
<i>Steel.</i>		Steel.
<i>Stone in the bladder.</i>		Lithic acid.

T

<i>Tartar.</i>	Acidulous tartarite of potash.
<i>Tartar, ammoniacal.</i>	Ammoniacal tartarite.
<i>Tartar, antimoniated.</i>	Antimoniated tartarite of potash.
<i>Tartar, calcareous.</i>	Tartarite of lime.
<i>Tartar chalybeate.</i>	Ferruginous tartarite of potash.
<i>Tartar, cretaceous.</i>	Carbonate of potash.
<i>Tartar, crude.</i>	Tartar.

Old Names.	T	New Names.
<i>apreous.</i>		Tartarite of copper.
<i>magnesia.</i>		Tartarite of magnesia.
<i>potash.</i>		Tartarite of potash.
<i>soda.</i>		Tartarite of soda.
<i>metic.</i>		Antimoniated tartarite of potash.
<i>duble martial.</i>		Ferruginous tartarite of potash.
<i>nephritic.</i>		Carbonate of potash.
<i>mercurial.</i>		Mercurial tartarite.
<i>sturnine.</i>		Tartarite of lead.
<i>bathe.</i>		Fluate of potash.
<i>duble.</i>		Tartarite of potash.
<i>libiated.</i>		Antimoniated tartarite of potash.
<i>artarised.</i>		Tartarite of potash.
<i>artarised, containing an-</i>	{	Tartarite of potash, with an ad-
		dition of antimony.
<i>nitrislated.</i>		Sulphate of potash.
<i>acid tincture of.</i>		Alcohol of potash.
<i>, spiritous.</i>		Resinous alcohol.
<i>imalis.</i>	{	Calcareous phosphate.
		Phosphate of lime.
<i>ase of alum.</i>		Alumine
<i>ase of ponderous spar.</i>		Barytes.
<i>caria.</i>		Lime, or calcareous earth.
<i>imine.</i>		Alumin.
<i>iata, crystallisable.</i>		Acetite of soda.
<i>iata tartaria.</i>		Acetite of potash.
<i>iata mercurialis.</i>		Acetite of mercury.
<i>neralis</i>		Acetite of soda.
<i>agnesiama.</i>		Carbonate of magnesia.
<i>riatica of M. Kirwan.</i>		Magnesia.
<i>nderosa.</i>		Barytes.
<i>nderosa aerated.</i>		Carbonate of barytes.
<i>cea.</i>		Silex, or siliceous earth.
<i>salts.</i>		Tunstates.
<i>ammoniacal.</i>		Ammoniacal tunstate.
<i>of potash.</i>		Tunitate of potash.
<i>mineral.</i>	{	Yellow mercurial oxide by sul-
		phuric acid.
<i>nitrous.</i>	{	Yellow mercurial oxide by ni-
		trous acid.
<i>teous.</i>		Tin
		Muriate of tin.

Old Names.	V	New Names.
<i>Verdegris.</i>		Green oxide of copper.
<i>Verdigris of commerce.</i>	{	Acetite of copper, with an excess of oxide of copper.
<i>Venus.</i>		Copper.
<i>Verdet (Fr.), or verdigris.</i>		Acetite of copper.
<i>Verdigris, distilled.</i>		Crystallised acetite of copper.
<i>Vitrum antimonii.</i>	{	Vitrous sulphurated oxide of antimony.
<i>Vivum argentum.</i>		Mercury.
<i>Vinegar, distilled.</i>		Acetous acid.
<i>Vinegar of Saturn.</i>		Acetite of lead.
<i>Vinegar, radical.</i>		Acetic acid.
<i>Vitriol, ammoniacal.</i>		Ammoniacal sulphate.
<i>Vitriol, white.</i>		Sulphate of zinc.
<i>Vitriol, blue.</i>		Sulphate of copper.
<i>Vitriol, calcareous.</i>		Sulphate of lime.
<i>Vitriol of antimony.</i>		Sulphate of antimony.
<i>Vitriol of silver.</i>		Sulphate of silver.
<i>Vitriol of clay.</i>		Sulphate of alumine.
<i>Vitriol of bismuth.</i>		Sulphate of bismuth.
<i>Vitriol of lime.</i>		Calcareous sulphate.
<i>Vitriol of Cyprus.</i>		Sulphate of copper.
<i>Vitriol of cobalt.</i>		Sulphate of cobalt.
<i>Vitriol of copper.</i>		Sulphate of copper.
<i>Vitriol of luna.</i>		Sulphate of silver.
<i>Vitriol of manganese.</i>		Sulphate of manganese.
<i>Vitriol of mercury.</i>		Sulphate of mercury.
<i>Vitriol of nickel.</i>		Sulphate of nickel.
<i>Vitriol of platina.</i>		Sulphate of platina.
<i>Vitriol of lead.</i>		Sulphate of lead.
<i>Vitriol of potash.</i>		Sulphate of potash.
<i>Vitriol of soda.</i>		Sulphate of soda.
<i>Vitriol of tin.</i>		Sulphate of tin.
<i>Vitriol of zinc.</i>		Sulphate of zinc.
<i>Vitriol, magnesian.</i>		Sulphate of magnesia.
<i>Vitriol, martial.</i>		Sulphate of iron.
<i>Vitriol, green.</i>		Sulphate of iron.
		W
<i>Water.</i>		Water.
<i>Water, aerated.</i>		Carbonic acid.

Old Names.	W	New Names.
<i>Water, lime.</i>		Lime-water.
<i>Water, Prussian-lime.</i>		Prussiate of lime.
<i>Water, distilled.</i>		Distilled water.
<i>Water, strong, or aqua fortis.</i>		Nitric acid of commerce.
<i>Waters, gaseous.</i>	{	Waters impregnate with carbonic acid.
<i>Waters, mothers.</i>		Saline deliquescent residue.
<i>Water, mercurial.</i>	{	Nitrate of mercury in a state of solution.
<i>Water, royal, or aqua regia.</i>		Nitro-muriatic acid.
<i>Waters, acidulous.</i>		Acidulous waters, or waters impregnated with carbonic acid.
<i>Waters hepatic.</i>		Sulphureous or sulphurated waters.
<i>Wolfram of Messrs d' Elbuzar.</i>		Tungsten.
	Z	
<i>Zinc.</i>		Zinc.
<i>Zaffre.</i>		Grey oxide of cobalt, with siliceous earth, or <i>zaffre</i> .

DICTIONARY

FOR THE

NEW CHEMICAL NOMENCLATURE.

Old Names.

New Names.

A

ACETATES.

Acetas, tis. f. m.

These are salts formed by the combination of the acetic acid (or radical vinegar) with different bases. The following names, with which there are none synonymous in the ancient Nomenclature, belong to this genus.

Acetate, aluminous.

— of alumine.

Acetas aluminofus.

Acetate, ammoniacal.

— of ammoniac *.

Acetas ammoniacalis.

* For the future, we shall not repeat these two modes of expressing the base of a neutral salt together, but use them indifferently. These instances already given, are enough to show, that either the substantive or the adjective may be used, at pleasure.

This observation extends also to the Latin Nomenclature.

<i>New Names.</i>	<i>A</i>	<i>Old Names.</i>
Acetate of antimony. <i>Acetas stibii.</i>		
Acetate of silver. <i>Acetas argenti.</i>		
Acetate of arsenic. <i>Acetas arsenici.</i>		
Acetate of barytes. <i>Acetas barytis, or baryta.</i>		
Acetate of bismuth. <i>Acetas bismuthi.</i>		
Acetate of lime. <i>Acetas calcis.</i>		
Acetate of cobalt. <i>Acetas cobalti.</i>		
Acetate of copper. <i>Acetas cupri.</i>		
Acetate of tin. <i>Acetas stanni.</i>		
Acetate of iron. <i>Acetas ferri.</i>		
Acetate of magnesia. <i>Acetas magnesia.</i>		
Acetate of manganese. <i>Acetas magnesi.</i>		
Acetate of mercury. <i>Acetas hydrargyri.</i>		
Acetate of molybdena. <i>Acetas molybdeni.</i>		
Acetate of nickel. <i>Acetas niccoli.</i>		
Acetate of gold. <i>Acetas auri.</i>		
Acetate of platina. <i>Acetas platini.</i>		
Acetate of lead. <i>Acetas plumbi.</i>		

New Names.	A	Old Names.
Acetate of potash. <i>Acetas potassa.</i>		
Acetate of soda. <i>Acetas soda.</i>		
Acetate of tungsten. <i>Acetas tungsteni.</i>		
Acetate of zinc. <i>Acetas zinci.</i>		
Acetite. <i>Acetis, itis. f. m.</i>		{ Salts formed by the union of the acetous acid, or distilled vi- negar, with different bases.
Acetite, aluminous. <i>Acetis aluminosus.</i>		{ <i>Acetited clay.</i> <i>Acetous salt of clay.</i>
Acetite, ammoniacal. <i>Acetis ammoniacalis.</i>		{ <i>Ammoniacal acetite.</i> <i>Ammoniacal acetous salt.</i> <i>Spirit of Mendererus.</i>
Acetite of antimony. <i>Acetis stibii.</i>		
Acetite of silver. <i>Acetis argenti.</i>		
Acetite of arsenic. <i>Acetis arsenicalis.</i>		{ <i>Fuming arsenico-acetous liquor of</i> <i>M. Cadet.</i>
Acetite of barytes. <i>Acetis baryticus.</i>		
Acetite of bismuth. <i>Acetis bismuthi.</i>		
Acetite of lime. <i>Acetis calcareus.</i>		{ <i>Acetited lime.</i> <i>Calcareous acetous salt.</i>
Acetite of cobalt. <i>Acetis cobalti.</i>		
Acetite of copper. <i>Acetis cupri.</i>		{ <i>Acetited copper.</i> <i>Verdigris.</i> <i>Distilled verdigris of commerce.</i> <i>Crystals of Venus.</i>
Acetite of tin. <i>Acetis stanni.</i>		

<i>New Names.</i>	A	<i>Old Names.</i>
Acetite of iron. <i>Acetis ferri.</i>	{	<i>Acetited iron.</i> <i>Martial acetous salt.</i>
Acetite of magnesia. <i>Acetis magnesiæ.</i>	{	<i>Magnesian acetous salt.</i> <i>Acetited magnesia.</i>
Acetite of mercury. <i>Acetis hydrargyri.</i>	{	<i>Acetited mercury.</i> <i>Terra foliata mercurialis.</i>
Acetite of molybdena. <i>Acetis molybdeni.</i>		
Acetite of nickel. <i>Acetis nicoli.</i>		
Acetite of gold. <i>Acetis auri.</i>		
Acetite of platina. <i>Acetis platini.</i>		
Acetite of lead. <i>Acetis plumbi.</i>	{	<i>Acetited lead.</i> <i>Vinegar of saturn.</i> <i>Salt or sugar of saturn.</i>
Acetite of potash. <i>Acetis potassæ, vel potassæus.</i>	{	<i>Acetited potash.</i> <i>Terra foliata tartari.</i>
Acetite of soda. <i>Acetis sodæ, vel sodaceus.</i>	{	<i>Acetited soda.</i> <i>Mineral acetous salt.</i> <i>Terra foliata mineralis.</i> <i>Crystallisable terra foliata.</i>
Acetite of tungsten. <i>Acetis tungsteni.</i>		
Acetite of zinc. <i>Acetis zinci.</i>	{	<i>Acetited zinc.</i> <i>Acetous salt of zinc.</i>
Acid, acetous. <i>Acidum acetosum.</i>	{	<i>Acetous acid.</i> <i>Distilled vinegar.</i>
Acid, acetic. <i>Acidum aceticum.</i>	{	<i>Radical vinegar.</i> <i>Spirit of Venus.</i>
Acid, arsenic. <i>Acidum arsenicum.</i>	{	<i>Arsenical acid.</i>
Acid, benzoic. <i>Acidum benzoicum.</i>	{	<i>Benzonic acid.</i> <i>Acid of benzoïn.</i> <i>Salt of benzoïn.</i>
Acid, sublimated benzoic. <i>Acidum benzoicum sublimatum.</i>	{	<i>Flowers of benzoïn.</i> <i>Volatile salt of benzoïn.</i>

New Names.	A	Old Names.
Acid, bomic. <i>Acidum bomicum.</i>	{	Acid of the silk worm. Bombycine acid.
Acid, boracic. <i>Acidum boracicum.</i>	{	Volatile narcotic salt of vitriol. Sedative salt. Acid of borax. Boracine acid.
Acid, carbonic. <i>Acidum carbonicum.</i>	{	Gas sylvestre. Spiritus sylvestris. Fixed air. Aërial acid. Atmospheric acid. Mephitic acid. Cretaceous acid. Carbonaceous acid.
Acid, citric. <i>Acidum citricum.</i>	{	Lemon juice. Citronian acid.
Acid, fluoric. <i>Acidum fluoricum.</i>	{	Fluoric acid. Spathose acid.
Acid, formic. <i>Acidum formicum.</i>	{	Acid of ants. Formicine acid.
Acid, gallic. <i>Acidum gallæ, seu gallaceum.</i>	{	Astringent principle. Gallic acid.
Acid, lactic. <i>Acidum lacticum.</i>	{	Sour whey. Galactic acid.
Acid, lithic. <i>Acidum lithicum.</i>	{	Acid of the stone in the bladder. Bezoardic acid. Lithiasic acid.
Acid, malic. <i>Acidum malicum.</i>	{	Acid of apples. Malusian acid.
Acid, molybdic. <i>Acidum molybdicum.</i>	{	Acid of molybdæna. Molybdic acid. Acid of Wolfram.
Acid, muriatic. <i>Acidum muriaticum.</i>	{	Acid of marine salt. Fuming spirit of salt. Marine acid.
Acid, oxygenated muriatic. <i>Acidum muriaticum oxygenatum.</i>	{	Dephlogisticated marine acid. Aërated marine acid.

New Names.	A	Old Names,
Acid, nitrous. <i>Acidum nitrosum.</i>		{ Ruddy nitrous acid. Phlogisticated nitrous acid. Fuming nitrous acid. Fuming spirit of nitre.
Acid, nitric. <i>Acidum nitricum.</i>		{ White nitrous acid. Nitric acid without gas. Dephlogisticated nitrous acid.
Acid, nitro-muriatic. <i>Acidum nitro-muriaticum.</i>		{ Aqua regia. Regaline acid.
Acid, oxalic. <i>Acidum oxallicum.</i>		{ Acid of sorrel. Oxalline acid. Saccharine acid. Acid of sugar.
Acid, phosphorus. <i>Acidum phosphorosum.</i>		{ Volatile phosphoric acid.
Acid, phosphoric. <i>Acidum phosphoricum.</i>		{ Phosphoric acid. Acid of urine.
Acid, prussic. <i>Acidum prussicum.</i>		{ Colouring matter of Prussian blue.
Acid, pyro-ligneous. <i>Acidum pyro-lignosum.</i>		{ Emphyreumatic acid spirit of wood.
Acid, pyro-mucous. <i>Acidum pyro mucosum</i>		{ Spirit of honey, sugar, &c. Syrupous acid.
Acid, pyro-tartarous. <i>Acidum pyro-tartarosum.</i>		{ Spirit of tartar.
Acid, saccho lactic. <i>Acidum saccho-lacticum.</i>		{ Acid of sugar of milk. Saccho-lactic acid.
Acid, sebacic. <i>Acidum setacicum.</i>		{ Sebaceous acid. Acid of tallow.
Acid, succinic. <i>Acidum succinicum.</i>		{ Acid of amber. Volatile salt of amber.
Acid, sulphureous. <i>Acidum sulphurosusum.</i>		{ Sulphureous acid. Volatile sulphureous acid. Phlogisticated vitriolic acid. Spirit of sulphur.
Acid, sulphuric. <i>Acidum sulphuricum.</i>		{ Acid of sulphur. Vitriolic acid. Oil of vitriol. Spirit of vitriol.

<i>New Names.</i>	A	<i>Old Names.</i>
Acid, tartareous. <i>Acidum tartarosum.</i>	{	Tartareous acid. Acid of tartar.
Acid tunstic. <i>Acidum tunsticum.</i>	{	Tungstic acid. Acid of tungsten. Acid of Wolfram.
Affinity. <i>Affinitas.</i>	{	Affinity.
Aggregation. <i>Aggregatio.</i>	{	Aggregation.
Aggregates. <i>Aggregata.</i>	{	Aggregates.
Atmospheric air. <i>Aer atmosphericus.</i>	{	Atmospheric air.
Alkalis. <i>Alkalia.</i>	{	Alkalis in general.
Alcohol. <i>Alcohol, indecl.</i>	{	Spirit of wine. Ardent spirit.
Alcohol of potash. <i>Alcohol potasse.</i>	{	Lilium of Paracelsus. Acrid tincture of tartar.
Alcohol, nitric. <i>Alcohol nitricum.</i>	{	Dulcified spirit of nitre.
Alcohols, resinous. <i>Alcohol resinosa.</i>	{	Spiritous tinctures.
Alloy. <i>Connubium metallicum.</i>	{	Alloy of metals.
Alumine. <i>Alumina.</i>	{	Earth of alum. Base of alum. Pure clay.
Amalgam.		Amalgam.
Ammoniac. <i>Ammoniaca.</i>	{	Causitic volatile alkali. Fluor volatile alkali. Volatile spirit of sal ammoniac.
Antimony. <i>Antimonium, stibium.</i>	{	Regulus of antimony.
Aroma. <i>Aroma.</i>	{	Spiritus rector. Odorate principle.
Arfeniates. <i>Arsenias, tis. f. m.</i>	{	Arsenical salts.

New Names.	A	Old Names.
Acidulous arseniate of potash. <i>Arsenias acidulus potassæ.</i>	}	<i>Macquer's arsenical neutral salt.</i>
Arseniate of alumine. <i>Arsenias aluminæ.</i>		
Arseniate of ammoniac. <i>Arsenias ammoniacæ, seu ammoniacalis.</i>	}	<i>Arsenical ammoniac.</i>
Arseniate of silver. <i>Arsenias argenti.</i>		
Arseniate of barytes. <i>Arsenias barytæ.</i>		
Arseniate of bismuth. <i>Arsenias bismuthi.</i>		
Arseniate of lime. <i>Arsenias calcis.</i>		
Arseniate of cobalt. <i>Arsenias cobalti.</i>		
Arseniate of copper. <i>Arsenias cupri.</i>		
Arseniate of tin. <i>Arsenias stanni.</i>		
Arseniate of iron. <i>Arsenias ferri.</i>		
Arseniate of magnesia. <i>Arsenias magnesiæ.</i>		
Arseniate of manganese. <i>Arsenias magnesi.</i>		
Arseniate of mercury. <i>Arsenias hydrargyri.</i>		
Arseniate of molybdena. <i>Arsenias molybdeni.</i>		
Arseniate of nickel. <i>Arsenias niccoli.</i>		
Arseniate of gold. <i>Arsenias auri.</i>		
Arseniate of platina. <i>Arsenias platini.</i>		

New Names.	A	Old Names.
Arsenate of lead. <i>Arsenias plumbi.</i>		
Arsenate of potash. <i>Arsenias potasse.</i>		
Arsenate of soda. <i>Arsenias soda.</i>		
Arsenate of tungsten. <i>Arsenias tungsteni.</i>		
Arsenate of zinc. <i>Arsenias zinçi.</i>		
Azote.		<i>Base of atmospheric mephitic.</i>
	B	
Barytes, or baryta. <i>Baryta.</i>		<i>Terra ponderosa.</i> <i>Earth of ponderous spar.</i> <i>Barotes.</i>
Balsams. <i>Balsama.</i>		<i>Balsams of Bucquet.*</i>
Benzoin. <i>Benzoe.</i>		<i>Benzoin.</i> <i>Benzone.</i>
Benzoate. <i>Benzoas, tis. f. m.</i>		A salt formed by the union of the benzoic acid with different bases. Salts of this kind have no names in the old Nomenclature.
Benzoate of alumine. <i>Benzoas aluminosus.</i>		
Benzoate of ammoniac. <i>Benzoas ammoniacalis.</i>		
Benzoate of antimony. <i>Benzoas stibii.</i>		

* Resins combined with a concrete acid salt.

<i>New Names.</i>	B	<i>Old Names.</i>
Benzoate of silver.		
<i>Benzoas argenti.</i>		
Benzoate of arsenic.		
<i>Benzoas arsenicalis.</i>		
Benzoate of barytes.		
<i>Benzoas baryticus.</i>		
Benzoate of bismuth.		
<i>Benzoas bismuthi.</i>		
Benzoate of lime.		
<i>Benzoas calcareus.</i>		
Benzoate of cobalt.		
<i>Benzoas cobalti.</i>		
Benzoate of copper.		
<i>Benzoas cupri.</i>		
Benzoate of tin.		
<i>Benzoas stanni.</i>		
Benzoate of iron.		
<i>Benzoas ferri.</i>		
Benzoate of magnesia.		
<i>Benzoas magnesie.</i>		
Benzoate of manganese.		
<i>Benzoas magnesi.</i>		
Benzoate of mercury.		
<i>Benzoas hydrargyri.</i>		
Benzoate of molybdena.		
<i>Benzoas molybdeni.</i>		
Benzoate of nickel.		
<i>Benzoas nicoli.</i>		
Benzoate of gold.		
<i>Benzoas auri.</i>		
Benzoate of platina.		
<i>Benzoas platini.</i>		
Benzoate of lead.		
<i>Benzoas plumbi.</i>		
Benzoate of potash.		
<i>Benzoas potasse.</i>		

New Names.	B	Old Names.
Benzoate of soda. <i>Benzoas soda.</i>		
Benzoate of tungsten. <i>Benzoas tungsteni.</i>		
Benzoate of zinc. <i>Benzoas zinci.</i>		
Bismuth. <i>Bismuthum.</i>	}	<i>Bismuth.</i>
Bitumens. <i>Bitumina.</i>	}	<i>Bitumens.</i>
Bombiate. <i>Bombias, tis. f. m.</i>	{	Salts formed by the union of the bombic acid with different bases. This genus of salts had no name in the old Nomenclature.
Bombiate of alumine. <i>Bombias aluminosus.</i>		
Bombiate of ammoniac. <i>Bombias ammoniacalis.</i>		
Bombiate of antimony. <i>Bombias stibii.</i>		
Bombiate of silver. <i>Bombias argenti.</i>		
Bombiat. of arsenic. <i>Bombias arsenicalis.</i>		
Bombiate of barytes. <i>Bombias baryticus.</i>		
Bombiate of bismuth. <i>Bombias bismuthi.</i>		
Bombiate of lime. <i>Bombias calcareus.</i>		
Bombiate of cobalt. <i>Bombias cobalti.</i>		
Bombiate of copper. <i>Bombias cupri.</i>		
Bombiate of tin. <i>Bombias stanni.</i>		

<i>New Names.</i>	<i>B</i>	<i>Old Names.</i>
Bombsite of iron. <i>Bombsite ferri.</i>		
Bombsite of magnesia. <i>Bombsite magnesia.</i>		
Bombsite of manganese. <i>Bombsite magnesi.</i>		
Bombsite of mercury. <i>Bombsite hydrargyri.</i>		
Bombsite of molybdena. <i>Bombsite molybdeni.</i>		
Bombsite of nickel. <i>Bombsite nicoli.</i>		
Bombsite of gold. <i>Bombsite auri.</i>		
Bombsite of platina. <i>Bombsite platini.</i>		
Bombsite of lead. <i>Bombsite plumbi.</i>		
Bombsite of potash. <i>Bombsite potasse.</i>		
Bombsite of soda. <i>Bombsite soda.</i>		
Bombsite of tungsten. <i>Bombsite tungsteni.</i>		
Bombsite of zinc. <i>Bombsite zinci.</i>		
Borate. <i>Boras, tis. f. m.</i>	}	<i>Borax.</i>
Borate, aluminous. <i>Boras aluminosus.</i>	}	<i>Argillaceous borax.</i>
Borate, ammoniacal. <i>Boras ammoniacalis.</i>	{	<i>Ammoniacal borax.</i>
		<i>Sedative sal ammoniac.</i>
Borate of antimony. <i>Boras stibii.</i>	}	<i>Borax of antimony.</i>
Borate of silver. <i>Boras argenti.</i>		

New Names.	B	Old Names.
Borate of arsenic. <i>Boras arsenici.</i>		
Borate of barytes, or baryta. <i>Boras baryte.</i>	}	Ponderous or heretic borax.
Borate of bismuth. <i>Boras bismuthi.</i>		
Borate of lime. <i>Boras calcis.</i>		
Borate of cobalt. <i>Boras cobalti.</i>	}	Borax of cobalt.
Borate of copper. <i>Boras cupri.</i>	}	Borax of copper.
Borate of tin. <i>Boras stanni.</i>		
Borate of iron. <i>Boras ferri.</i>	}	Borax of iron.
Borate of magnesia. <i>Boras magnesia.</i>	}	Magnesian borax.
Borate of manganese. <i>Boras magnesi.</i>		
Borate of mercury. <i>Boras mercurii.</i>	{	Mercurial borax.
		Mercurial sedative salt.
Borate of molybdena. <i>Boras molybdeni.</i>		
Borate of nickel. <i>Boras niccoli.</i>		
Borate of gold. <i>Boras auri.</i>		
Borate of platina. <i>Boras platini.</i>		
Borate of lead. <i>Boras plumbi.</i>		
Borate of potash. <i>Boras potasse.</i>	}	Vegetable borax.
Borate of soda. <i>Boras soda.</i>	{	Common borax saturated with lactic acid.

New Names.	B	Old Names.
Borate of tungsten. <i>Boras tungsteni.</i>		
Borate of zinc. <i>Boras zinci.</i>		} <i>Borax of zinc.</i>
		{ <i>Crude borax.</i>
Borate of soda, or borate super-		{ <i>Tinckal.</i>
saturated with soda.		{ <i>Chrysocolle.</i>
		{ <i>Borax of commerce.</i>

C

Caloric. <i>Caloricum.</i>		{ <i>Latent heat.</i>
		{ <i>Fixed heat.</i>
		{ <i>Principle of heat.</i>
Camphor. <i>Camphora.</i>		} <i>Camphor.</i>
		{ A salt formed by the combi-
		nation of camphoric acid with
		different bases.
		{ These salts were not known
		formerly ; and accordingly they
		have no names in the old No-
		menclature.
Camphorate of alumine. <i>Camphoras aluminosus.</i>		
Camphorate of ammoniac. <i>Camphoras ammoniacalis.</i>		
Camphorate of antimony. <i>Camphoras stibii.</i>		
Camphorate of silver. <i>Camphoras argenti.</i>		
Camphorate of arsenic. <i>Camphoras arsenicalis.</i>		
Camphorate of barytes. <i>Camphoras baryticus.</i>		

New Names.

C

Old Names.

Camphorate of bismuth.

Camphoras bismuthi.

Camphorate of lime.

Camphoras calcis.

Camphorate of cobalt.

Camphoras cobalti.

Camphorate of copper.

Camphoras cupri.

Camphorate of tin.

Camphoras stanni.

Camphorate of iron.

Camphoras ferri.

Camphorate of magnesia.

Camphoras magnese.

Camphorate of manganese.

Camphoras magnesi.

Camphorate of mercury.

Camphoras mercurii.

Camphorate of molybdena.

Camphoras molybdeni.

Camphorate of nickel.

Camphoras niccoli.

Camphorate of gold.

Camphoras auri.

Camphorate of platina.

Camphoras platini.

Camphorate of lead.

Camphoras plumbi.

Camphorate of potash.

Camphoras potasse.

Camphorate of soda.

Camphoras sode.

Camphorate of tungsten.

Camphoras tungsteni.

Camphorate of zinc.

Camphoras zinci.

<i>New Names</i>	C	<i>Old Names.</i>
Carbone. <i>Carbonicum.</i>	}	<i>Pure coal.</i>
Carbonate. <i>Carbonas, tis, f. m.</i>	{	A salt formed by the union of carbonic acid with different bases.
Carbonate of alumine. <i>Carbonas aluminosus.</i>	}	<i>Cretaceous clay.</i>
Carbonate, ammoniacal. <i>Carbonas ammoniaca.</i>	{	<i>Ammoniacal chalk.</i> <i>Cretaceous ammoniacal salt.</i> <i>Concrete volatile alkali.</i> <i>Ammoniacal mephite.</i> <i>English sal volatile.</i>
Carbonate of antimony. <i>Carbonas antimonii.</i>		
Carbonate of silver. <i>Carbonas argenti.</i>		
Carbonate of arsenic. <i>Carbonas arsenici.</i>		
Carbonate of barytes. <i>Carbonas baryticus.</i>	{	<i>Barotic or ponderous chalk.</i> <i>Aërated ponderous earth.</i> <i>Effervescent barotes.</i> <i>Barotic mephite.</i>
Carbonate of bismuth. <i>Carbonas bismuthi.</i>		
Calcareous carbonate. <i>Carbonas calcareus.</i>	{	<i>Chalk.</i> <i>Limestone.</i> <i>Calcareous mephite.</i> <i>Aërated calcareous earth.</i> <i>Effervescent calcareous earth.</i> <i>Calcareous spar.</i> <i>Cream of lime.</i>
Carbonate of cobalt. <i>Carbonas cobalti.</i>		
Carbonate of copper. <i>Carbonas cupri.</i>		
Carbonate of tin. <i>Carbonas stanni.</i>		

Dictionary for the

New Names.	S	Old Names.
Carbonate of iron. <i>Carbonas ferri.</i>	{	Aperient saffron of mars. Rust of iron. Aerated iron. Martial chalk. Martial mephite.
Carbonate of magnesia. <i>Carbonas magnesia.</i>		Magnesian earth. White Magnesia. Aerated magnesia of Bergman. Cretaceous magnesia. Magnesian chalk. Effervescent magnesia. Mephite of magnesia. Kirwan's muriatic earth. Powder of Count Palma, and of Sentinelli.
Carbonate of manganese. <i>Carbonas magnesii.</i>		
Carbonate of mercury. <i>Carbonas hydrargyri.</i>		
Carbonate of molybdena. <i>Carbonas molybdeni.</i>		
Carbonate of nickel. <i>Carbonas niccoli.</i>		
Carbonate of gold. <i>Carbonas auri.</i>		
Carbonate of platina. <i>Carbonas platini.</i>		
Carbonate of lead. <i>Carbonas plumbi.</i>	{	Chalk of lead. Spathose lead. Mephite of lead.
Carbonate of potash. <i>Carbonas potassa.</i>		Fixed salt of tartar. Vegetable fixed alkali. Aerated vegetable fixed alkali. Cretaceous tartar. Mephitic tartar. Mephite of potash. Nitre fixed by itself. Alkabeft of Van Helmont.

<i>New Names.</i>	T	<i>Old Names.</i>
Carbonate of soda. <i>Carbonas soda.</i>		{ <i>Natrum or Natron.</i> <i>Base of marine salt.</i> <i>Marine or mineral alkali.</i> <i>Crystals of soda.</i> <i>Cretaceous soda.</i> <i>Aerated soda.</i> <i>Effervescent soda.</i> <i>Mepbite of soda.</i> <i>Aerated mineral fixed alkali.</i> <i>Effervescent mineral fixed alkali.</i> { <i>Chalk of soda.</i>
Carbonate of tungsten. <i>Carbonas tungsteni.</i>		
Carbonate of zinc. <i>Carbonas zinci.</i>		{ <i>Chalk of zinc.</i> <i>Aerated zinc.</i> { <i>Mepbite of zinc.</i>
Carbure of iron.		<i>Plumbago.</i>
Calcareous earth or lime, diluted in water.		} <i>Milk of lime.</i>
Calcareous earth or lime.		{ <i>Calcareous earth.</i> <i>Quicklime.</i>
Citrate. <i>Citras, tis, f. m.</i>		{ A salt formed by the combination of the acid of citrons with different bases. { This salt had no name in the old nomenclature.
Citrate of alumine. <i>Citras aluminosus.</i>		
Citrate of ammoniac. <i>Citras ammoniacalis.</i>		
Citrate of antimony. <i>Citras stibii.</i>		
Citrate of silver. <i>Citras argenti.</i>		
Citrate of arsenic. <i>Citras arsenicatis.</i>		
Citrate of barytes. <i>Citras baryticus.</i>		

New Names.

A

Old Names.

Citrate of bismuth.

Citras bismuthi.

Citrate of lime.

Citras calcareus.

Citrate of cobalt.

Citras cobalti.

Citrate of copper.

Citras cupri.

Citrate of tin.

Citras stanni.

Citrate of iron.

Citras ferri.

Citrate of magnesia.

Citras magnesiæ.

Citrate of manganese.

Citras magnesiæ.

Citrate of mercury.

Citras mercurii.

Citrate of molybdena.

Citras molybdeni.

Citrate of nickel.

Citras niccoli.

Citrate of gold.

Citras auri.

Citrate of platina.

Citras platini.

Citrate of lead.

Citras plumbi.

Citrate of potash.

Citras potassæ.

Citrate of soda.

Citras sodæ.

Citrate of tungsten.

Citras tungsteni.

Citrate of zinc.

Citras zinci.

<i>New Names.</i>	C	<i>Old Names.</i>
Clay, a mixture of aluminous and siliceous earth, <i>argilla</i> .	{	Clay. Potter's earth. Argillaceous earth.
Cobalt.		Regulus of cobalt. Cobalt, or <i>cobolt</i> .
Copper. <i>Cuprum</i> .		Copper. Venus.

D

Diamond.	Diamond.
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E

Ether, acetic. <i>Ether aceticum</i> .	{	Acetous ether.
Ether, muriatic. <i>Ether muriaticum</i> .		Marine ether.
Ether, nitric. <i>Ether nitricum</i> .	{	Nitrous ether.
Ether, sulphuric. <i>Ether sulphuricum</i> .		Vitriolic ether.
Extractive principle. <i>Extractum</i> .	{	Extract.

F

Fecula. <i>Fecula</i> .	{	Fecula of plants.
Fluate. <i>Fluas, tis. f. m.</i>		A salt formed by the combination of the fluoric acid with different bases.
Fluate of alumine. <i>Fluas aluminæ</i> .	{	Argillaceous fluor.
		Spathose clay.

New Names.	F	Old Names.
Fluate, ammoniacal. <i>Fluas ammoniacalis.</i>		{ Ammoniacal sparry salt. Sparry ammoniac. Ammoniacal spar. Ammoniacal fluor.
Fluate of antimony. <i>Fluas stibii.</i>		
Fluate of silver. <i>Fluas argenti.</i>		
Fluate of arsenic. <i>Fluas arsenicalis.</i>		
Fluate of barytes. <i>Fluas barytæ.</i>		{ Ponderous fluor. Barotic fluor.
Fluate of bismuth. <i>Fluas bismuthi.</i>		
Fluate of lime. <i>Fluas calcareus.</i>		{ Fluor spar. Vitreous spar. Cubic spar. Phosphoric spar. Sparry fluor.
Fluate of cobalt. <i>Fluas cobalti.</i>		
Fluate of copper. <i>Fluas cupri.</i>		
Fluate of tin. <i>Fluas stanni.</i>		
Fluate of iron. <i>Fluas ferri.</i>		
Fluate of magnesia. <i>Fluas magnesia.</i>		{ Fluorated magnesia. Sparry magnesia. Magnesian fluor.
Fluate of manganese. <i>Fluas magnesi.</i>		
Fluate of mercury. <i>Fluas mercurii.</i>		
Fluate of molybdena. <i>Fluas molybdeni.</i>		
Fluate of nickel. <i>Fluas niccoli.</i>		

<i>New Names.</i>	F	<i>Old Names.</i>
Fluate of gold. <i>Fluas auri.</i>		
Fluate of platina. <i>Fluas platini.</i>		
Fluate of lead. <i>Fluas plumbi.</i>		
Fluate of potash. <i>Fluas potasse.</i>		{ <i>Tartareous fluor.</i> { <i>Sparry tartar.</i>
Fluate of soda. <i>Fluas sode.</i>		{ <i>Fluor of soda.</i> { <i>Sparry soda.</i>
Fluate of tungsten. <i>Fluas tungsteni.</i>		
Fluate of zinc. <i>Fluas zinci.</i>		
Formiate. <i>Formias, tis. f. m.</i>		{ Salt formed by the combina- { tion of the formic acid with dif- { ferent bases. { This genus of salt has no { name in the old nomenclature.
Formiate of alumine. <i>Formias aluminosus.</i>		
Formiate of ammoniac. <i>Formias ammoniacalis.</i>		
Formiate of antimony. <i>Formias stibii.</i>		
Formiate of silver. <i>Formias argenti.</i>		
Formiate of arsenic. <i>Formias arsenicalis.</i>		
Formiate of barytes. <i>Formias baryticus.</i>		
Formiate of bismuth. <i>Formias bismuthi.</i>		
Formiate of lime. <i>Formias calcareus.</i>		

New Names.	F	Old Names.
Formiate of cobalt.		
<i>Formias cobalti.</i>		
Formiate of copper.		
<i>Formias cupri.</i>		
Formiate of tin.		
<i>Formias stanni.</i>		
Formiate of iron.		
<i>Formias ferri.</i>		
Formiate of magnesia.		
<i>Formias magnesiæ.</i>		
Formiate of manganese.		
<i>Formias magnesi.</i>		
Formiate of mercury.		
<i>Formias mercurij.</i>		
Formiate of molybdena.		
<i>Formias molybdeni.</i>		
Formiate of nickel.		
<i>Formias niccoli.</i>		
Formiate of gold.		
<i>Formias auri.</i>		
Formiate of platina.		
<i>Formias platini.</i>		
Formiate of lead.		
<i>Formias plumbi.</i>		
Formiate of potash.		
<i>Formias potassæ.</i>		
Formiate of soda.		
<i>Formias sodæ.</i>		
Formiate of tungsten.		
<i>Formias tungsteni.</i>		
Formiate of zinc.		
<i>Formias zinci.</i>		

<i>New Names.</i>	G	<i>Old Names.</i>
Gas.	{	Gas.
Gas.		Elastic fluids.
		Aëriform fluids.
Gas, acetous acid.	{	Acetous acid gas.
Gas acidum acetosum.		
		Fixed air.
Gas, carbonic acid.	{	Solid air of Hales.
Gas acidum carbonicum.		Cretaceous acid gas.
		Mephitic gas.
		Aërial acid.
Gas, fluoric acid.	{	Sparry acid gas.
Gas acidum fluoricum.		Fluoric acid gas.
		Marine air.
Gas, muriatic acid.	{	Marine acid gas.
Gas acidum muriaticum.		Muriatic acid gas.
Gas, oxygenated muriatic acid.	{	Aërated muriatic acid gas.
Gas acidum muriaticum oxygenatum.		Dephlogisticated marine acid.
Gas, nitrous acid.	{	Nitrous acid gas.
Gas acidum nitrosus.		
Gas, prussic acid.	{	Prussian gas.
Gas acidum prussicum.		
Gas, sulphureous acid.	{	Sulphureous acid gas.
Gas acidum sulphureum.		Vitriolic acid air.
		Alkaline gas.
Gas, ammoniacal.	{	Alkaline air.
Gas ammoniacale.		Volatile alkaline gas.
		Vitiated air.
Gas, azotic.	{	Impure air.
Gas azoticum.		Phlogisticated air.
		Phlogisticated gas.
		Atmospheric mephitic.
Gas, hydrogenous.	{	Inflammable gas.
Gas hydrogenium.		Inflammable air.
		Phlogiston of Mr Kirwan.
Vol. IV.	Z	

New Names.	G	Old Names.
Gas, carbonated hydrogenous. <i>Gas hydrogenium carbonatum.</i>	}	Carbonaceous inflammable gas.
Gas, hydrogenous, of marshes. <i>Gas hydrogenium paludum.</i>		Mephitized inflammable gas. Inflammable gas of marshes.
Gas, phosphorized hydrogenous. <i>Gas hydrogenium phosphorifatum.</i>		Phosphoric gas.
Gas, sulphurated hydrogenous. <i>Gas hydrogenium sulphuratum.</i>		Hepatic gas.
Gas nitrous. <i>Gas nitrosum.</i>		Nitrous gas.
Gas, oxigenous. <i>Gas oxigenium.</i>	}	Vital air. Pure air. Dephlogisticated air.
Gluten, or the glutinous principle. <i>Gluten.</i>		Gluten of farina or of wheat. Vegeto-animal matter.
Gold. <i>Aurum.</i>	}	Gold.

I

Iron. <i>Ferrum.</i>	}	Iron.
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K

Lactate.
Lactas, tis, f, m.

Salts formed by the union of the acid of sour whey, or lactic acid, with different bases. These salts were not known before Scheele; and their properties being as yet but little examined, they have hitherto received no name.

<i>New Names.</i>	L	<i>Old Names.</i>
Lactate of alumine.		
<i>Lactas aluminofus.</i>		
Lactate of ammoniac.		
<i>Lactas ammoniacalis.</i>		
Lactate of antimony.		
<i>Lactas stibii.</i>		
Lactate of silver.		
<i>Lactas argenti.</i>		
Lactate of arsenic.		
<i>Lactas arsenicalis.</i>		
Lactate of barytes.		
<i>Lactas baryticus.</i>		
Lactate of bismuth.		
<i>Lactas bismuthi.</i>		
Lactate of lime.		
<i>Lactas calcareus.</i>		
Lactate of cobalt.		
<i>Lactas cobalti.</i>		
Lactate of copper.		
<i>Lactas cupri.</i>		
Lactate of tin.		
<i>Lactas stanni.</i>		
Lactate of iron.		
<i>Lactas ferri.</i>		
Lactate of magnesia.		
<i>Lactas magnesia.</i>		
Lactate of manganese.		
<i>Lactas magnesi.</i>		
Lactate of mercury.		
<i>Lactas hydrargyri.</i>		
Lactate of molybdena.		
<i>Lactas molybdeni.</i>		
Lactate of nickel.		
<i>Lactas niccoli.</i>		
Lactate of gold.		
<i>Lactas auri.</i>		

New Names.	L	Old Names.
Lactate of platina. <i>Lactas platini.</i>		
Lactate of lead. <i>Lactas plumbi.</i>		
Lactate of potash. <i>Lactas potasse.</i>		
Lactate of soda. <i>Lactas soda.</i>		
Lactate of tungsten. <i>Lactas tungsteni.</i>		
Lactate of zinc. <i>Lactas zinci.</i>		
Lead. <i>Plumbum.</i>	{ <i>Lead.</i> <i>Saturn.</i>	
Light.	<i>Light.</i>	
Lithiate. <i>Lithias, tis. f. m.</i>	{ Salts formed by the union of the lithic acid, or urinary cal- culus, with different bases. { These salts are not compre- hended in the ancient Nomen- clature, being unknown before Scheele.	
Lithiate of alumine. <i>Lithias aluminosus.</i>		
Lithiate of ammoniac. <i>Lithias ammoniacalis.</i>		
Lithiate of antimony. <i>Lithias stibii.</i>		
Lithiate of silver. <i>Lithias argenti.</i>		
Lithiate of arsenic. <i>Lithias arsenicalis.</i>		
Lithiate of barytes. <i>Lithias baryticus.</i>		
Lithiate of bismuth. <i>Lithias bismuthi.</i>		
Lithiate of lime. <i>Lithias calcareus.</i>		

<i>New Names.</i>	L	<i>Old Names.</i>
Lithiate of cobalt. <i>Lithias cobalti.</i>		
Lithiate of copper. <i>Lithias cupri.</i>		
Lithiate of tin. <i>Lithias stanni.</i>		
Lithiate of iron. <i>Lithias ferri.</i>		
Lithiate of magnesia. <i>Lithias magnesiæ.</i>		
Lithiate of manganese. <i>Lithias magnesi.</i>		
Lithiate of mercury. <i>Lithias hydrargyri.</i>		
Lithiate of molybdena. <i>Lithias molybdeni.</i>		
Lithiate of nickel. <i>Lithias niccæ.</i>		
Lithiate of gold. <i>Lithias auri.</i>		
Lithiate of platina. <i>Lithias platini.</i>		
Lithiate of lead. <i>Lithias plumbi.</i>		
Lithiate of potash. <i>Lithias potassæ.</i>		
Lithiate of soda. <i>Lithias sodæ.</i>		
Lithiate of tungsten. <i>Lithias tungsteni.</i>		
Lithiate of zinc. <i>Lithias zinci.</i>		

M

Malate.

Malas, tis. f. m.

Z 3

{ Salts formed by the union of
the malic acid, or acid of ap-
ples, with different bases.
This genus of salts has not
yet obtained a name in the old
Nomenclature.

New Names.	M	Old Names.
Malate of alumine.		
<i>Malas aluminosus.</i>		
Malate of ammoniac.		
<i>Malas ammoniacalis.</i>		
Malate of antimony.		
<i>Malas stibii.</i>		
Malate of silver.		
<i>Malas argenti.</i>		
Malate of arsenic.		
<i>Malas arsenicalis.</i>		
Malate of barytes.		
<i>Malas baryticus.</i>		
Malate of bismuth.		
<i>Malas bismuthi.</i>		
Malate of lime.		
<i>Malas calcareus.</i>		
Malate of cobalt.		
<i>Malas cobalti.</i>		
Malate of copper.		
<i>Malas cupri.</i>		
Malate of tin.		
<i>Malas stanni.</i>		
Malate of iron.		
<i>Malas ferri.</i>		
Malate of magnesia.		
<i>Malas magnesæ.</i>		
Malate of manganese.		
<i>Malas magnesi.</i>		
Malate of mercury.		
<i>Malas hydrargyri.</i>		
Malate of molybdena.		
<i>Malas molybdeni.</i>		
Malate of nickel.		
<i>Malas niccoli.</i>		
Malate of gold.		
<i>Malas auri.</i>		
Malate of platina.		
<i>Malas platini.</i>		

New Names.	M	Old Names.
Malate of lead. <i>Malas plumbi.</i>		
Malate of potash. <i>Malas potasse.</i>		
Malate of soda. <i>Malas sode.</i>		
Malate of tungsten. <i>Malas tungsteni.</i>		
Malate of zinc. <i>Malas zinci.</i>		
Manganese. <i>Magnesium.</i>	}	<i>Regulus of manganese.</i>
Mercury. <i>Hydrargyrum.</i>	{	<i>Mercury.</i> <i>Quicksilver.</i>
Molybdate. <i>Molybdas, tis. f. m.</i>	{	Salt formed by the union of the molybdic acid with different bases. This genus of salts had no name in the old Nomenclature.
Molybdate of alumine. <i>Molybdas aluminosus.</i>		
Molybdate of ammoniac. <i>Molybdas ammoniacalis.</i>		
Molybdate of antimony. <i>Molybdas stibii.</i>		
Molybdate of silver. <i>Molybdas argenti.</i>		
Molybdate of arsenic. <i>Molybdas arsenicalis.</i>		
Molybdate of barytes. <i>Molybdas baryticus.</i>		
Molybdate of bismuth. <i>Molybdas bismuthi.</i>		
Molybdate of lime. <i>Molybdas calcareus.</i>		
Molybdate of cobalt. <i>Molybdas cobalti.</i>		
Molybdate of copper. <i>Molybdas cupri.</i>		

New Names.	M	Old Names.
Molybdate of tin. <i>Molybdaſtanni.</i>		
Molybdate of iron. <i>Molybdaſferri.</i>		
Molybdate of magnesia. <i>Molybdaſmagneſie.</i>		
Molybdate of manganese. <i>Molybdaſmagneſii.</i>		
Molybdate of mercury. <i>Molybdaſhydrargyri.</i>		
Molybdate of nickel. <i>Molybdaſniccoli.</i>		
Molybdate of gold. <i>Molybdaſauri.</i>		
Molybdate of platina. <i>Molybdaſplatini.</i>		
Molybdate of lead. <i>Molybdaſplumbi.</i>		
Molybdate of pothaſh. <i>Molybdaſpotaſſæ.</i>		
Molybdate of ſoda. <i>Molybdaſſoda.</i>		
Molybdate of tungſten. <i>Molybdaſtungſteni.</i>		
Molybdate of zinc. <i>Molybdaſzinci.</i>		
Molybdena.		<i>Regulus of molybdena.</i>
Mucus.		<i>Mucilage.</i>
Muriate.		{ Salt formed by the union of th muriatic acid with different ba
<i>Murias, tis, f. m.</i>		
Muriate of alumine.		{ <i>Marine alum.</i> <i>Argillaceous marine ſalt.</i>
<i>Murias aluminofus.</i>		
Muriate of ammoniac.		{ <i>Sal ammoniac.</i> <i>Salmiac.</i>
<i>Murias ammoniacaliſ.</i>		
Muriate of antimony.		{ <i>Muriate of antimony.</i>
<i>Murias ſtibii.</i>		

<i>New Names.</i>	M	<i>Old Names.</i>
Muriate, fuming, of antimony. <i>Murias stibii fumans.</i>		} <i>Butter of antimony.</i>
Muriate of silver. <i>Murias argenti.</i>		} <i>Corneous silver.</i> } <i>Luna cornea.</i>
Muriate of arsenic. <i>Murias arsenicalis.</i>		
Muriate, sublimated, of arsenic. <i>Murias arsenicalis sublimatus.</i>		} <i>Butter of arsenic.</i>
Muriate of barytes. <i>Murias baryticus.</i>		} <i>Barotic marine salt.</i>
Muriate of bismuth. <i>Murias bismuthi.</i>		} <i>Muriate of bismuth.</i>
Muriate, sublimated, of bismuth. <i>Murias bismuthi sublimatus.</i>		} <i>Butter of bismuth.</i>
Muriate of lime. <i>Murias calcareus.</i>		} <i>Mother water of marine salt.</i> } <i>Calcareous marine salt.</i> } <i>Fixed sal ammoniac.</i>
Muriate of cobalt. <i>Murias cobalti.</i>		} <i>Ink of sympathy.</i>
Muriate of copper. <i>Murias cupri.</i>		} <i>Muriate of copper.</i>
Muriate, sublimated ammoniacal of copper. <i>Murias cupri ammoniacalis sublimatus.</i>		} <i>Cupreous ammoniacal flowers.</i>
Muriate of tin. <i>Murias stanni.</i>		} <i>Salt of Jupiter.</i>
Muriate, concrete, of tin. <i>Murias stanni concretus.</i>		} <i>Solid butter of tin of M. Baumé.</i> } <i>Corneous tin.</i>
Muriate, fuming, of tin. <i>Murias stanni fumans.</i>		} <i>Fuming liquor of Libavius.</i>
Muriate, sublimated, of tin. <i>Murias stanni sublimatus.</i>		} <i>Butter of tin.</i>
Muriate of iron. <i>Murias ferri.</i>		} <i>Muriate of iron.</i> } <i>Marine salt of iron.</i>

New Names.	M	Old Names.
Muriate, sublimated ammoniacal, of iron. <i>Murias ferri ammoniacalis sublimatus.</i>		Martial ammoniacal flowers.
Muriate of magnesia. <i>Murias magnesia.</i>		Marine salt with a base of magnesia.
Muriate of manganese. <i>Murias magnesi.</i>		Muriate of manganese.
Muriate, corrosive, of mercury. <i>Murias hydrargyri corrosivus.</i>		Corrosive sublimate.
Muriate, sweet, of mercury. <i>Murias hydrargyri dulcis.</i>		Sweet sublimate.
Muriate, sweet sublimated, of mercury. <i>Murias hydrargyri sublimatus.</i>		Aquila alba.
Muriate of mercury and ammoniac. <i>Murias hydrargyri et ammoniacalis.</i>		Sal almbroth.
Muriate of mercury by precipitation. <i>Murias hydrargyri precipitatus.</i>		Salt of wisdom. White precipitated muriate.
Muriate of molybdena. <i>Murias molybdeni.</i>		
Muriate of nickel. <i>Murias niccoli.</i>		
Muriate of gold. <i>Murias auri.</i>		Muriate of gold. Regaline salt of gold.
Muriate of platina. <i>Murias platini.</i>		Muriate of platina. Regaline salt of platina.
Muriate of lead. <i>Murias plumbi.</i>		Corneous lead. Muriate of lead.
Muriate of potash. <i>Murias potassæ.</i>		Febrifuge salt of Sylvius.
Muriate of soda. <i>Murias sodæ.</i>		Marine salt.

New Names.	M	Old Names.
Muriate, fossil, of soda. <i>Murias sode fossilis.</i>	}	<i>Sal gem.</i>
Muriate of tungsten. <i>Murias tungsteni.</i>		
Muriate of zinc. <i>Murias zinci.</i>	}	<i>Marine salt of zinc.</i> <i>Muriate of zinc.</i>
Muriate, sublimated, of zinc. <i>Murias zinci sublimatus.</i>		
Muricates, oxygenated.	}	<i>Butter of zinc.</i>
Muriate, oxygenated, of potash. <i>Murias oxigenatus potasse.</i>	}	New combinations of the oxygenated muriatic acid with potash and soda, discovered by M. Berthollet.
Muriate, oxygenated, of soda. <i>Murias oxigenatus sode.</i>		

N

Nitrate. <i>Nitras, tis. f. m.</i>	}	Salts formed by the combina- tion of the nitric acid with dif- ferent bases.
Nitrate of alumine. <i>Nitras aluminofus.</i>		
Nitrate of ammoniac. <i>Nitras ammoniacalis.</i>	}	<i>Nitrous alum.</i> <i>Argillaceous nitre.</i>
Nitrate of antimony. <i>Nitras stibii.</i>		
Nitrate of silver. <i>Nitras argenti.</i>	}	<i>Ammoniacal nitrous salt.</i> <i>Ammoniacal nitre.</i>
Nitrate, melted, of silver. <i>Nitras argenti fusus.</i>		
Nitrate of arsenic. <i>Nitras arsenicalis.</i>	}	<i>Lunar nitre.</i> <i>Nitre of silver.</i> <i>Crytals of the moon.</i>
	}	<i>Infernal stone.</i>
	}	<i>Nitre of arsenic.</i>

<i>New Names.</i>	N	<i>Old Names.</i>
Nitrate of barytes. <i>Nitras baryticus.</i>	{	<i>Nitre of ponderous earth.</i> <i>Barotic nitre.</i>
Nitrate of bismuth. <i>Nitras bismuthi.</i>	}	<i>Nitre of bismuth.</i>
Nitrate of lime. <i>Nitras calcareus.</i>	{	<i>Calcareous nitre.</i> <i>Mother water of nitre.</i>
Nitrate of cobalt. <i>Nitras cobalti.</i>	}	<i>Nitre of cobalt.</i>
Nitrate of copper. <i>Nitras cupri.</i>	}	<i>Nitrate of copper.</i>
Nitrate of tin. <i>Nitras stanni.</i>	{	<i>Nitre of tin.</i> <i>Stanno-nitrous salt.</i>
Nitrate of iron. <i>Nitras ferri.</i>	{	<i>Nitre of iron.</i> <i>Martial nitre.</i>
Nitrate of magnesia. <i>Nitras magnesiæ.</i>		<i>Nitre of magnesia;</i> <i>Magnesian nitre.</i>
Nitrate of manganese. <i>Nitras magnesiæ.</i>		<i>Nitre of manganese.</i>
Nitrate of mercury. <i>Nitras hydrargyri.</i>		<i>Mercurial nitre.</i> <i>Nitre of mercury.</i>
Nitrate of mercury in a state of solution. <i>Nitras hydrargyri solutus.</i>	{	<i>Mercurial water.</i>
Nitrate of molybdena. <i>Nitras molybdeni.</i>		
Nitrate of nickel. <i>Nitras niccoli.</i>		<i>Nitre of nickel.</i>
Nitrate of gold. <i>Nitras auri.</i>		
Nitrate of platina. <i>Nitras platini.</i>		
Nitrate of lead. <i>Nitras plumbi.</i>		<i>Nitre of lead.</i> <i>Saturnine nitre</i>
Nitrate of potash, or nitre. <i>Nitras potassæ, vel nitrum.</i>		<i>Nitre.</i> <i>Saltpetre.</i>

<i>New Names.</i>	N	<i>Old Names.</i>
Nitrate of soda. <i>Nitras soda.</i>		{ <i>Cubic nitre.</i> <i>Rhomboidal nitre.</i>
Nitrate of tungsten. <i>Nitras tungsteni.</i>		
Nitrate of zinc. <i>Nitras zinci.</i>		{ <i>Nitre of zinc.</i>
Nitrite. <i>Nitris, tis. f. m.</i>		{ Salt formed by the combination of the <i>nitrous</i> * acid with different bases. This genus of salts had no name in the old Nomenclature, being unknown before the late discoveries.
Nitrite of alumine. <i>Nitris aluminosus.</i>		
Nitrite of ammoniac. <i>Nitris ammoniacalis.</i>		
Nitrite of antimony. <i>Nitris stibii.</i>		
Nitrite of silver. <i>Nitris argenti.</i>		
Nitrite of arsenic. <i>Nitris arsenicalis.</i>		
Nitrite of barytes. <i>Nitris baryticus.</i>		
Nitrite of bismuth. <i>Nitris bismuthi.</i>		
Nitrite of lime. <i>Nitris calcareus.</i>		
Nitrite of cobalt. <i>Nitris cobalti.</i>		
Nitrite of copper. <i>Nitris cupri.</i>		
Nitrite of tin. <i>Nitris stanni.</i>		

* That is, with spirit of nitre containing less origene than *nitric* acid, which forms *nitrates*.

New Names.	N	Old Names.
Nitrite of iron.		
<i>Nitrus ferri.</i>		
Nitrite of magnesia.		
<i>Nitris magnesie.</i>		
Nitrite of manganese.		
<i>Nitrus magnesi.</i>		
Nitrite of mercury.		
<i>Nitris hydrargyri.</i>		
Nitrite of molybdena.		
<i>Nitris molybdeni.</i>		
Nitrite of nickel.		
<i>Nitris niccoli.</i>		
Nitrite of gold.		
<i>Nitris auri.</i>		
Nitrite of platina.		
<i>Nitris platini.</i>		
Nitrite of lead.		
<i>Nitris plumbi.</i>		
Nitrite of potash.		
<i>Nitris potasse.</i>		
Nitrite of soda.		
<i>Nitris soda.</i>		
Nitrite of tungsten.		
<i>Nitris tungsteni.</i>		
Nitrite of zinc.		
<i>Nitris zinci.</i>		

O

Oils, empyreumatic.	}	<i>Empyreumatic oils.</i>
<i>Olea empyreumatica.</i>		
Oils, fixed.		
<i>Olea fixa.</i>	}	<i>Fat oils.</i>
		<i>Sweet oils.</i>
Oils, volatile.	}	<i>Oils obtained by expression.</i>
<i>Olea volatilina.</i>		<i>Essential oils.</i>
		<i>Essences.</i>

New Names.	N	Old Names.
Oxalate.		{ Salt formed by the combination of the oxalic acid with different bases. Scarce any of the salts of this genus had a name in the old Nomenclature.
<i>Oxalas, tis. f. m.</i>		
Oxalate, acidulous, of ammoniac.		
<i>Oxalas acidulus ammoniacalis.</i>		
Oxalate, acidulous, of potash.	{	Salt of sorrel of commerce.
<i>Oxalas acidulus potassæ.</i>		
Oxalate, acidulous, of soda.		
<i>Oxalas acidulus sodæ.</i>		
Oxalate of alumine.		
<i>Oxalas aluminosus.</i>		
Oxalate of ammoniac.		
<i>Oxalas ammoniacalis.</i>		
Oxalate of antimony.		
<i>Oxalas stibii.</i>		
Oxalate of silver.		
<i>Oxalas argenti.</i>		
Oxalate of arsenic.		
<i>Oxalas arsenicalis.</i>		
Oxalate of barytes.		
<i>Oxalas baryticus.</i>		
Oxalate of bismuth.		
<i>Oxalas bismuthi.</i>		
Oxalate of lime.		
<i>Oxalas calcareus.</i>		
Oxalate of cobalt.		
<i>Oxalas cobalti.</i>		
Oxalate of copper.		
<i>Oxalas cupri.</i>		
Oxalate of tin.		
<i>Oxalas stanni.</i>		
Oxalate of iron.		
<i>Oxalas ferri.</i>		
Oxalate of magnesia.		
<i>Oxalas magnesiæ.</i>		

New Names.

C

Old Names.

Oxalate of manganese.

Oxalas magnesi.

Oxalate of mercury.

Oxalas hydrargyri.

Oxalate of molybdena.

Oxalas molybdeni.

Oxalate of nickel.

Oxalas niccoli.

Oxalate of gold.

Oxalas auri.

Oxalate of platina.

Oxalas platini.

Oxalate of lead.

Oxalas plumbi.

Oxalate of potash.

Oxalas potassæ.

Oxalate of soda.

Oxalas sodæ.

Oxalate of tungsten.

Oxalas tungsteni.

Oxalate of zinc.

Oxalas zinci.

Oxide, arsenical, of potash.

Oxidum arsenicale potassæ.} *Liver of arsenic.*

Oxide, white, of arsenic.

Oxidum arsenici album.} *White arsenic.*} *Calx of arsenic.*

Oxide of antimony, BY THE MU-

RIATIC AND NITRIC ACIDS.

Oxidum sibi acidis muria-
tico et nitrico confectum.} *Mineral bezoar.*Oxide of antimony, white, by
nitre.*Oxidum sibi album nitro*
confectum.} *Diaphoretic antimony.*} *Ceruse of antimony.*} *Materia perlata of Kerkrin-*
*gius.*Oxide, white sublimated, of an-
timony.*Oxidum sibi album sublima-*
tum.} *Snow of antimony*} *Flowers of antimony.*} *Silver flowers of regulus of anti-*
mony.

New Names.	O	Old Names.
Oxide of antimony, by the muriatic acid. <i>Oxidum stibii acido muriatico confectum.</i>		Powder of Algaroth.
Oxide, sulphurated, of antimony. <i>Oxidum stibii sulphuratum.</i>		Liver of antimony.
Oxide, sulphurated semi-vitreous, of antimony. <i>Oxidum stibii sulphuratum semi-vitreum.</i>		Saffron of metals.
Oxide, orange-coloured sulphurated, of antimony. <i>Oxidum stibii sulphuratum aurantiacum.</i>		Gilded sulphur of antimony.
Oxide, red sulphurated, of antimony. <i>Oxidum stibii sulphuratum rubrum.</i>		Kermes mineral.
Oxide, vitreous sulphurated, of antimony. <i>Oxidum stibii sulphuratum vitreum.</i>		Glass of antimony.
Oxide, brown vitreous sulphurated, of antimony. <i>Oxidum stibii sulphuratum vitreum fuscum.</i>		Rubine of antimony.
Oxide, white sublimated, of arsenic. <i>Oxidum arsenici album sublimatum.</i>		Flowers of arsenic.
Oxide, yellow sulphurated, of arsenic. <i>Oxidum arsenici sulphuratum luteum.</i>		Orpiment.
Oxide, red sulphurated, of arsenic. <i>Oxidum arsenici sulphuratum rubrum.</i>		Red arsenic. Realgar, or realal.

New Names.	O	Old Names.
Oxide, white, of bismuth, by the nitric acid. <i>Oxidum bismuthi album acido nitrico confectum.</i>	}	<i>Magistery of bismuth.</i> <i>White paint.</i>
Oxide, sublimated, of bismuth. <i>Oxidum bismuthi sublimatum.</i>		<i>Flowers of bismuth.</i>
Oxide, grey, of cobalt with filix, or zaffre. <i>Oxidum cobalti cinereum cum filice.</i>	}	<i>Zaffre.</i>
Oxide, vitreous, of cobalt. <i>Oxidum cobalti vitreum.</i>		<i>Azure.</i> <i>Smalt.</i>
Oxide, green acetated, of copper. <i>Oxidum cupri viride acetatum.</i>		<i>Verdigrise.</i> <i>Rust of copper.</i>
Oxide, grey, of tin. <i>Oxidum flanni cinereum.</i>	}	<i>Putty of tin.</i>
Oxide, sublimated, of tin. <i>Oxidum flanni sublimatum.</i>		<i>Flowers of tin.</i>
Oxides of iron. <i>Oxida ferri.</i>	}	<i>Saffrons of Mars.</i>
Oxide, brown, of iron. <i>Oxidum ferri fuscum.</i>		<i>Astringent saffron of Mars.</i>
Oxide, yellow, of iron. <i>Oxidum ferri luteum.</i>	}	<i>Ochre.</i>
Oxide, black, of iron. <i>Oxidum ferri nigrum.</i>		<i>Martial Ethiops.</i>
Oxide, red, of iron. <i>Oxidum ferri rubrum.</i>	}	<i>Colcothar.</i>
Oxide, white, of manganese. <i>Oxidum magnesi album.</i>		<i>White calx of manganese.</i>
Oxide, black, of manganese. <i>Oxidum magnesi nigrum.</i>	}	<i>Black magnesia.</i> <i>Glass-makers soap.</i> <i>Stone of Perigueux.</i>
Oxide, yellow, of mercury, by the nitric acid. <i>Oxidum hydrargyri luteum acido nitrico confectum.</i>		<i>Nitrous turbit.</i>

New Names.	B	Old Names.
Oxide, yellow, of mercury by the sulphuric acid. <i>Oxidum hydrargyri luteum acido sulphurico confectum.</i>	}	Mineral turbith. Yellow precipitate.
Oxide, blackish, of mercury. <i>Oxidum hydrargyri nigrum.</i>		Ethiops per se.
Oxide, red, of mercury by the nitric acid. <i>Oxidum hydrargyri rubrum acido nitrico confectum.</i>	}	Red precipitate.
Oxide, red, of mercury by fire. <i>Oxidum hydrargyri rubrum per ignem.</i>		Precipitate per se.
Oxide, black sulphurated, of mercury. <i>Oxidum hydrargyri sulphuratum nigrum.</i>	}	Mineral ethiops.
Oxide, red sulphurated, of mercury. <i>Oxidum hydrargyri sulphuratum rubrum.</i>		Cinnabar.
Oxide, ammoniacal, of gold. <i>Oxidum auri ammoniacale.</i>	}	Fulminating gold.
Oxide of gold by tin. <i>Oxidum auri per stannum.</i>		Precipitate of gold by tin. Purple of Cassius.
Oxides of lead. <i>Oxida plumbi.</i>	}	Calces of lead.
Oxide, white, of lead by the acetic acid. <i>Oxidum plumbi album per acidum acetosum.</i>		White of lead.
Oxide, semi-vitreous, of lead, or litharge. <i>Oxidum plumbi semi-vitreum.</i>	}	Litharge.
Oxide, yellow, of lead. <i>Oxidum plumbi luteum.</i>		Massicot.
Oxide, red, of lead, or minium. <i>Oxidum plumbi rubrum.</i>	}	Minium.

New Names.	§	Old Names.
Oxide, sublimated, of zinc. <i>Oxidum zinci sublimatum.</i>	{	<i>Philosophic wool.</i> <i>Philosophic cotton.</i> <i>Flowers of zinc.</i> <i>Pempholyon.</i>
Oxides, metallic. <i>Oxida metallica.</i>	}	<i>Metallic ashes.</i>
Oxides, metallic sublimated. <i>Oxida metallica sublimata.</i>	}	<i>Metallic fumes.</i>
Oxygene. <i>Oxygenium.</i>	{	<i>Gygema.</i> <i>Base of vital air.</i> <i>Acidifying principle.</i> <i>Euphyant air.</i> <i>Principium fertile.</i>

P

Phosphate. <i>Phosphas, tis. f. m.</i>	{	Salt formed by the union of the phosphoric acid with di- fferent bases.
Phosphate of alumine. <i>Phosphas aluminosus.</i>		
Phosphate of ammoniac. <i>Phosphas ammoniacalis.</i>	}	<i>Phosphoric ammoniac.</i> <i>Ammoniacal phosphate.</i>
Phosphate of antimony. <i>Phosphas stibii.</i>		
Phosphate of silver. <i>Phosphas argenti.</i>		
Phosphate of arsenic. <i>Phosphas arsenicalis.</i>		
Phosphate of barytes. <i>Phosphas baryticus.</i>		
Phosphate of bismuth. <i>Phosphas bismuthi.</i>		
Phosphate, calcareous, or of lime. <i>Phosphas calcareus.</i>	}	<i>Earth of bones.</i> <i>Calcareous phosphate.</i> <i>Animal earth.</i>

New Names.	C	Old Names.
Phosphate of cobalt. <i>Phosphas cobalti.</i>		
Phosphate of copper. <i>Phosphas cupri.</i>		
Phosphate of tin. <i>Phosphas stanni.</i>		
Phosphate of iron. <i>Phosphas ferri.</i>		{ Syderite. Iron of water. Ore of iron from märzbes.
Phosphate of magnesia. <i>Phosphas magnesiæ.</i>		{ Phosphate of magnesia.
Phosphate of manganese. <i>Phosphas magnesiæ.</i>		
Phosphate of mercury. <i>Phosphas hydrargyri.</i>		{ Rose precipitate of Lemery
Phosphate of molybdena. <i>Phosphas molybdeni.</i>		
Phosphate of nickel. <i>Phosphas niccoli.</i>		
Phosphate of gold. <i>Phosphas auri.</i>		
Phosphate of platina. <i>Phosphas platini.</i>		
Phosphate of lead. <i>Phosphas plumbi.</i>		
Phosphate of potash. <i>Phosphas potassæ.</i>		
Phosphate of soda. <i>Phosphas sodæ.</i>		
Phosphate of soda and ammonia. <i>Phosphas sodæ et ammoniacalis.</i>		{ Native salt of urine. Fusible salts of urine.
Phosphate, supersaturated, of soda. <i>Phosphas supersaturatus sodæ.</i>		{ Sal admirabile perlatum.

New Names.	P	Old Names.
Phosphate of tungsten. <i>Phosphas tungsteni.</i>		
Phosphate of zinc. <i>Phosphas zinci.</i>		
Phosphite. <i>Phosphis, tis. f. m.</i>		} Salt formed by the union of the phosphorous acid with dif- ferent bases.
Phosphite of alumine. <i>Phosphis aluminosus.</i>		
Phosphite of ammoniac. <i>Phosphis ammoniacalis.</i>		
Phosphite antimony. <i>Phosphis stibii.</i>		
Phosphite of silver. <i>Phosphis argenti.</i>		
Phosphite of arsenic. <i>Phosphis arsenicalis.</i>		
Phosphite of barytes. <i>Phosphis baryticus.</i>		
Phosphite of bismuth. <i>Phosphis bismuthi.</i>		
Phosphite of lime. <i>Phosphis calcareus.</i>		
Phosphite of cobalt. <i>Phosphis cobalti.</i>		
Phosphite of copper. <i>Phosphis cupri.</i>		
Phosphite of tin. <i>Phosphis stanni.</i>		
Phosphite of iron. <i>Phosphis ferri.</i>		
Phosphite of magnesia. <i>Phosphis magnesæ.</i>		
Phosphite of manganese. <i>Phosphis magnesi.</i>		
Phosphite of mercury. <i>Phosphis hydrargyri.</i>		

<i>New Names.</i>	P	<i>Old Names.</i>
Phosphite of molybdena. <i>Phosphis molybdæni.</i>		
Phosphite of nickel. <i>Phosphis niccoli.</i>		
Phosphite of gold. <i>Phosphis auri.</i>		
Phosphite of platina. <i>Phosphis platini.</i>		
Phosphite of lead. <i>Phosphis plumbi.</i>		
Phosphite of potash. <i>Phosphis potassæ.</i>		
Phosphite of soda. <i>Phosphis sodæ.</i>		
Phosphite of tungsten. <i>Phosphis tungsteni.</i>		
Phosphite of zinc. <i>Phosphis zinci.</i>		
Phosphorus. <i>Phosphorum.</i>	}	<i>Phosphorus of Kunkel.</i>
Phosphure. <i>Phosphoretum.</i>	}	Combination of non-oxygenated phosphorus with different bases.
Phosphure of copper. <i>Phosphoretum cupri.</i>		
Phosphure of iron. <i>Phosphoretum ferri.</i>	}	<i>Syderum of Bergman.</i> <i>Syderatete of M. de Morveau.</i> <i>Regulus of syderite.</i>
Pyro-lignite. <i>Pyro lignis, tis. f. m.</i>	}	Salt formed by the union of the pyro-ligneous acid with different bases. These salts had no name in the old Nomenclature.
Pyro-lignite of alumine. <i>Pyro-lignis aluminosus.</i>		
Pyro-lignite of ammoniac. <i>Pyro-lignis ammoniacalis.</i>		

New Names.

P

New Names.

Pyro-lignite of antimony.

Pyro-lignis stibii.

Pyro-lignite of silver.

Pyro-lignis argenti.

Pyro-lignite of arsenic.

Pyro-lignis arsenicalis.

Pyro-lignite of barytes.

Pyro-lignis baryticus.

Pyro-lignite of bismuth.

Pyro-lignis bismuthi.

Pyro-lignite of lime.

Pyro-lignis calcareus.

Pyro-lignite of cobalt.

● *Pyro-lignis cobalti.*

Pyro-lignite of copper.

Pyro-lignis cupri.

Pyro-lignite of tin.

Pyro-lignis stanni.

Pyro-lignite of iron.

Pyro-lignis ferri.

Pyro-lignite of magnesia.

Pyro-lignis magnesia.

Pyro-lignite of manganese.

Pyro-lignis magnesi.

Pyro-lignite of mercury.

Pyro-lignis hydrargyri.

Pyro-lignite of molybdena.

Pyro-lignis molybdeni.

Pyro-lignite of nickel.

Pyro-lignis niccoli.

Pyro-lignite of gold.

Pyro-lignis auri.

Pyro-lignite of platina.

Pyro-lignis platini.

Pyro-lignite of lead.

Pyro-lignis plumbi.

Pyro-lignite of potash.

Pyro-lignis potassæ.

New Names.

P

Old Names.

Pyro-lignite of soda.

Pyro-lignis soda.

Pyro-lignite of tungsten.

Pyro-lignis tungsteni.

Pyro-lignite of zinc.

Pyro-lignis zinci.

Pyro-mucites.

Pyro-mucis.

Pyro-mucite of alumine.

Pyro-mucis aluminosus.

Pyro-mucite of ammoniac.

Pyro-mucis ammoniacalis.

Pyro-mucite of antimony.

Pyro-mucis stibii.

Pyro-mucite of silver.

Pyro-mucis argenti.

Pyro-mucite of arsenic.

Pyro-mucis arsenicalis.

Pyro-mucite of barytes.

Pyro-mucis baryticus.

Pyro-mucite of bismuth.

Pyro-mucis bismuthi.

Pyro-mucite of lime.

Pyro-mucis calcareus.

Pyro-mucite of cobalt.

Pyro-mucis cobalti.

Pyro-mucite of copper.

Pyro-mucite of copper.

Pyro-mucite of tin.

Pyro-mucis stanni.

Pyro-mucite of iron.

Pyro-mucis ferri.

{ Salts formed by the union of
the pyro-mucous acid with dif-
ferent bases.

{ This species of salts has not
yet obtained a name in the old
Nomenclature.

New Names.	P	Old Names.
Pyro-mucite of magnesia. <i>Pyro-mucis magnesia.</i>		
Pyro-mucite of manganese. <i>Pyro-mucis magnesi.</i>		
Pyro-mucite of mercury. <i>Pyro-mucis hydrargyri.</i>		
Pyro-mucite of molybdena. <i>Pyro-mucis molybdeni.</i>		
Pyro-mucite of nickel. <i>Pyro-mucis niccoli.</i>		
Pyro-mucite of gold. <i>Pyro-mucis auri.</i>		
Pyro-mucite of platina. ● <i>Pyro-mucis platini.</i>		
Pyro-mucite of lead. <i>Pyro-mucis plumbi.</i>		
Pyro-mucite of potash. <i>Pyro-mucis potassa.</i>		
Pyro-mucite of soda. <i>Pyro-mucis soda.</i>		
Pyro-mucite of tungsten. <i>Pyro-mucis tungsteni.</i>		
Pyro-mucite of zinc. <i>Pyro-mucis zinci.</i>		
Pyro-tartarites. <i>Pyro-tartaris, tis. f. m.</i>		} Salts formed by the union of the pyro-tartareous acid with different bases.
Pyro-tartarite of alumine. <i>Pyro-tartaris aluminosus.</i>		
Pyro-tartarite of ammoniac. <i>Pyro-tartaris ammoniacalis.</i>		
Pyro-tartarite of antimony. <i>Pyro-tartaris stibii.</i>		
Pyro-tartarite of silver. <i>Pyro-tartaris argenti.</i>		
Pyro-tartarite of arsenic. <i>Pyro-tartaris arsenicalis.</i>		

<i>New Names.</i>	<i>P</i>	<i>Old Names.</i>
Pyro-tartarite of barytes.		
<i>Pyro-tartaris baryticus.</i>		
Pyro-tartarite of bismuth.		
<i>Pyro-tartaris bismuthi.</i>		
Pyro-tartarite of lime.		
<i>Pyro-tartaris calcareus.</i>		
Pyro-tartarite of cobalt.		
<i>Pyro-tartaris cobalti.</i>		
Pyro-tartarite of copper.		
<i>Pyro-tartaris cupri.</i>		
Pyro-tartarite of tin.		
<i>Pyro-tartaris stanni.</i>		
Pyro-tartarite of iron.		
<i>Pyro-tartaris ferri.</i>		
Pyro-tartarite of magnesia.		
<i>Pyro-tartaris magnesiae.</i>		
Pyro-tartarite of manganese.		
<i>Pyro-tartaris magnesi.</i>		
Pyro-tartarite of mercury.		
<i>Pyro-tartaris hydrargyri.</i>		
Pyro-tartarite of molybdena.		
<i>Pyro-tartaris molybdeni.</i>		
Pyro-tartarite of nickel.		
<i>Pyro-tartaris niccoli.</i>		
Pyro-tartarite of gold.		
<i>Pyro-tartaris auri.</i>		
Pyro-tartarite of platina.		
<i>Pyro-tartaris platini.</i>		
Pyro-tartarite of lead.		
<i>Pyro-tartaris plumbi.</i>		
Pyro-tartarite of potash.		
<i>Pyro-tartaris potasse.</i>		
Pyro-tartarite of soda.		
<i>Pyro-tartaris soda.</i>		
Pyro-tartarite of tungsten.		
<i>Pyro-tartaris tungsteni.</i>		
Pyro-tartarite of zinc.		
<i>Pyro-tartaris zinci.</i>		

New Names.	P.	Old Names.
Platina. <i>Platinum.</i>		{ <i>Juan blanca.</i> <i>Platina.</i> <i>Platina del pinto.</i>
Potash. <i>Potassa, e.</i>		{ <i>Vegetable caustic fixed alkali.</i>
Potash, melted. <i>Potassa fusa.</i>		{ <i>Lapis causticus.</i>
Potash, siliceous fluid. <i>Potassa silicea fluida.</i>		{ <i>Liquor of flints.</i>
Prussiate. <i>Prussias, tis. f. m.</i>		{ Salts formed by the union of the Prussic acid, or colouring matter of Prussian blue, with different bases. This genus of salts had no name in the old Nomenclature.
Prussiate of alumine. <i>Prussias aluminosus.</i>		
Prussiate of ammoniac. <i>Prussias ammoniacalis.</i>		
Prussiate of antimony. <i>Prussias stibii.</i>		
Prussiate of silver. <i>Prussias argenti.</i>		
Prussiate of arsenic. <i>Prussias arsenicalis.</i>		
Prussiate of barytes. <i>Prussias baryticus.</i>		
Prussiate of bismuth. <i>Prussias bismuthi.</i>		
Prussiate of lime. <i>Prussias calcareus.</i>		{ <i>Calcareous prussiate.</i> <i>Prussian lime-water.</i>
Prussiate of cobalt. <i>Prussias cobalti.</i>		
Prussiate of copper. <i>Prussias cupri.</i>		
Prussiate of tin. <i>Prussias stanni.</i>		

New Names.	P	Old Names.
Prussiate of iron. <i>Prussias ferri.</i>		{ <i>Prussian blue.</i> <i>Berlin blue.</i>
Prussiate of magnesia. <i>Prussias magnesie.</i>		
Prussiate of manganese. <i>Prussias magnesi.</i>		
Prussiate of mercury. <i>Prussias hydrargyri.</i>		
Prussiate of molybdena. <i>Prussias molybdeni.</i>		
Prussiate of nickel. <i>Prussias niccoli.</i>		
Prussiate of gold. <i>Prussias auri.</i>		
Prussiate of platina. <i>Prussias platini.</i>		
Prussiate of lead. <i>Prussias plumbi.</i>		
Prussiate of potash. <i>Prussias potasse.</i>		{ <i>Liquor saturated with the colour- ing part of Prussian blue.</i>
Prussiate, ferruginous saturated, of potash. <i>Prussias potasse ferruginosus saturatus.</i>		{ <i>Prussian alkali.</i>
Prussiate, ferruginous, not sa- turated, of potash. <i>Prussias potasse ferruginosus non saturatus.</i>		{ <i>Phlogisticated alkali.</i>
Prussiate of soda. <i>Prussias sodæ.</i>		
Pyrophorus of Homberg. <i>Pyrophorum Hombergii.</i>		{ <i>Pyrophorus of Homberg.</i>
R		
Resins. <i>Resinæ.</i>		{ <i>Resins.</i>

New Names.

S

Old Names.

Saccho-late.

Saccholas, tis. f. m.

Salts formed by the union of the saccho-lactic acid with different bases.

This species of salts has no name in the old Nomenclature.

Saccho-late of alumine.

Saccholas aluminosus.

Saccho-late of ammoniac.

Saccholas ammoniacalis.

Saccho-late of antimony.

Saccholas stibii.

Saccho-late of sulphur.

Saccholas argenti.

Saccho-late of arsenic.

Saccholas arsenicalis.

Saccho-late of barytes.

Saccholas baryticus.

Saccho-late of bismuth.

Saccholas bismuthi.

Saccho-late of lime.

Saccholas calcareus.

Saccho-late of cobalt.

Saccholas cobalti.

Saccho-late of copper.

Saccholas cupri.

Saccho-late of tin.

Saccholas stanni.

Saccho-late of iron.

Saccholas ferri.

Saccho-late of magnesia.

Saccholas magnesia.

Saccho-late of manganese.

Saccholas magnesi.

Saccho-late of mercury.

Saccholas hydrargyri.

New Names.	S	Old Names.
Saccho-late of molybdena. <i>Saccholas molybdeni.</i>		
Saccho-late of nickel. <i>Saccholas niccoli.</i>		
Saccho-late of gold. <i>Saccholas auri.</i>		
Saccho-late of platina. <i>Saccholas platini.</i>		
Saccho-late of lead. <i>Saccholas plumbi.</i>		
Saccho-late of potash. <i>Saccholas potassæ.</i>		
Saccho-late of soda. <i>Saccholas sodæ.</i>		
Saccho-late of tungsten. <i>Saccholas tungsteni.</i>		
Saccho-late of zinc. <i>Saccholas zinci.</i>		
Saponulæ. <i>Saponuli.</i>	{	Combinations of volatile or essential oils with different bases.
Saponulæ, acid. <i>Saponuli acidi.</i>	{	Combinations of volatile or essential oils with different acids.
Saponula of alumine. <i>Saponulus aluminosus.</i>	{	Soap composed of volatile oil, combined with the base of alum.
Saponula, ammoniacal. <i>Saponulus ammoniacalis.</i>	{	Soap composed of volatile oil, combined with ammoniac.
Saponula of barytes. <i>Saponulus barytæ.</i>	{	Soap composed of volatile oil, combined with barytes.
Saponula of lime. <i>Saponulus calcareus.</i>	{	Soap composed of volatile oil, combined with lime.
Saponula of potash. <i>Saponulus potassæ.</i>	{	Soap composed of volatile oil, combined with potash, or <i>soap of Starkey.</i>
Saponulæ of soda. <i>Saponuli sodæ.</i>	{	Soaps composed of volatile oils, combined with fixed mineral alkali, or soda.
Saponulæ, metallic. <i>Saponuli metallici.</i>	{	Soaps composed of volatile oils, united to metallic substances.

New Names.	S	Old Names.
Sebate. <i>Sebas, tis. f. m.</i>	{	Salts formed by the union the acid of grease, or the fixed acid, with different bases. These salts have no name the ancient Nomenclature
Sebate of alumine. <i>Sebas aluminosus.</i>		
Sebate of ammoniac. <i>Sebas ammonicalis.</i>		
Sebate of antimony. <i>Sebas stibii.</i>		
Sebate of silver. <i>Sebas argenti.</i>		
Sebate of arsenic. <i>Sebas arsenicalis.</i>		
Sebate of barytes. <i>Sebas baryticus.</i>		
Sebate of bismuth. <i>Sebas bismuthi.</i>		
Sebate of lime. <i>Sebas calcareus.</i>		
Sebate of cobalt. <i>Sebas cobalti.</i>		
Sebate of copper. <i>Sebas cupri.</i>		
Sebate of tin. <i>Sebas stanni.</i>		
Sebate of iron. <i>Sebas ferri.</i>		
Sebate of magnesia. <i>Sebas magnesiæ.</i>		
Sebate of manganese. <i>Sebas magnesiæ.</i>		
Sebate of mercury. <i>Sebas hydrargyri.</i>		
Sebate of molybdena. <i>Sebas molybdeni.</i>		

New Names.	S	Old Names.
Sebate of nickel. <i>Sebas niccoli.</i>		
Sebate of gold. <i>Sebas auri.</i>		
Sebate of platina. <i>Sebas platini.</i>		
Sebate of lead. <i>Sebas plumbi.</i>		
Sebate of potash. <i>Sebas potasse.</i>		
Sebate of soda. <i>Sebas soda.</i>		
Sebate of tungsten. <i>Sebas tungsteni.</i>		
Sebate of zinc. <i>Sebas zinci.</i>		
Semi-metals.		<i>Semi-metals.</i>
Silex, or siliceous earth. <i>Silica, terra silicea.</i>		{ <i>Quartzose earth.</i> <i>Siliceous earth.</i> <i>Vitrifiable earth.</i>
Silver. <i>Argentum.</i>		{ <i>Diana.</i> <i>Luna.</i> <i>Silver.</i>
Soaps. <i>Sapones.</i>		{ Combinations of fat or fixed oils with different bases.
Soaps, acid. <i>Sapones acidi.</i>		{ Combinations of fat or fixed oils with different acids.
Soap of alumine. <i>Sapo aluminosus.</i>		{ Soap composed of fixed oil, combined with alumine.
Soap, ammoniacal. <i>Sapo ammoniacalis.</i>		{ Soap composed of fixed oil, combined with volatile alkali.
Soap of barytes. <i>Sapo baryticus.</i>		{ Soap composed of fixed oil, combined with barytes.
Soap of lime. <i>Sapo calcareus.</i>		{ Soap composed of fixed oil, combined with lime.
Soap of magnesia. <i>Sapo magnesiæ.</i>		{ Soap composed of fixed oil, combined with magnesia.

New Names.	S	Old Names.
Soap of potash. <i>Sapo potasse.</i>	{	Soap composed of fixed oil, combined with fixed vegetable alkali.
Soap of soda. <i>Sapo soda.</i>	{	Soap composed of fixed oil, combined with fixed mineral alkali.
Soaps, metallic. <i>Sapones metallici.</i>	{	Combinations of fat or fixed oils with metallic substances.
Soda. <i>Soda.</i>	{	<i>Cauſtic ſoda.</i> <i>Marine alkali.</i> <i>Mineral alkali.</i>
Starch. <i>Amylum.</i>	}	<i>Starch.</i>
Steel. <i>Chalybs.</i>	}	<i>Steel.</i>
Succinate. <i>Succinas, tis. f. m.</i>	{	Salts formed by the combi- nation of the ſuccinic acid with different baſes.
Succinate of alumine. <i>Succinas aluminofus.</i>		
Succinate of ammoniac. <i>Succinas ammoniacalis.</i>		
Succinate of antimony. <i>Succinas ſtibii.</i>		
Succinate of aſenic. <i>Succinas aſenicalis.</i>		
Succinate of barytes. <i>Succinas baryticus.</i>		
Succinate of biſmuth. <i>Succinas biſmuthi.</i>		
Succinate of lime. <i>Succinas calcareus.</i>		
Succinate of cobalt. <i>Succinas cobaltii.</i>		
Succinate of copper. <i>Succinas cupri.</i>		
Succinate of tin. <i>Succinas ſtanni.</i>		
Succinate of iron. <i>Succinas ferri.</i>		

<i>New Names.</i>	S	<i>Old Names:</i>
Succinate of magnesia. <i>Succinas magnesie.</i>		
Succinate of manganese. <i>Succinas magnesi.</i>		
Succinate of mercury. <i>Succinas hydrargyri.</i>		
Succinate of molybdena. <i>Succinas molybdeni.</i>		
Succinate of nickel. <i>Succinas niccoli.</i>		
Succinate of gold. <i>Succinas auri.</i>		
Succinate of platina. <i>Succinas platini.</i>		
Succinate of lead. <i>Succinas plumbi.</i>		
Succinate of potash. <i>Succinas potasse.</i>		
Succinate of soda. <i>Succinas sodæ.</i>		
Succinate of tungsten. <i>Succinas tungsteni.</i>		
Succinate of zinc. <i>Succinas zinci.</i>		
Succinum, or amber. <i>Succinum.</i>		{ <i>Kaṛabeum.</i> <i>Yellow amber.</i> <i>Amber.</i>
Sugar. <i>Saccharum.</i>		{ <i>Sugar.</i>
Sugar, crystallised. <i>Saccharum crystallisatum.</i>		{ <i>Sugar candy.</i>
Sugar of milk. <i>Saccharum lactis.</i>		{ <i>Sugar of milk.</i> <i>Salt of milk.</i>

New Names.	S	Old Names.
Sulphates. <i>Sulphas, tis. f. m.</i>		{ Salts formed by the combination of the sulphuric acid with different bases.
Sulphate of alumine. <i>Sulphas aluminosus.</i>		{ Alum. { Argillaceous vitriol.
Sulphate, ammoniacal. <i>Sulphas ammoniacalis.</i>		{ Ammoniacal vitriolic salt. { Ammoniacal salt (secret of Glauber's. { Ammoniacal vitriol.
Sulphate of antimony. <i>Sulphas stibii.</i>		{ Vitriol of antimony.
Sulphate of silver. <i>Sulphas argenti.</i>		{ Vitriol of silver. { Vitriol of luna.
Sulphate of arsenic. <i>Sulphas arsenicalis.</i>		{ Vitriol of arsenic.
Sulphate of barytes. <i>Sulphas baryticus.</i>		{ Ponderous spar. { Barotic vitriol.
Sulphate of bismuth. <i>Sulphas bismuthi.</i>		{ Vitriol of bismuth.
Sulphate of lime. <i>Sulphas calcareus.</i>		{ Vitriol of lime. { Calcareous vitriol. { Selenite. { Gypsum.
Sulphate of cobalt. <i>Sulphas cobalti.</i>		{ Vitriol of cobalt.
Sulphate of copper. <i>Sulphas cupri.</i>		{ Vitriol of Cyprus. { Blue vitriol. { Vitriol of copper, or of Venus. { Blue copperas.
Sulphate of tin. <i>Sulphas stanni.</i>		{ Vitriol of tin.
Sulphate of iron. <i>Sulphas ferri.</i>		{ Martial vitriol. { Green vitriol. { Vitriol of iron. { Green copperas.

New Names.	N	Old Names.
Sulphate of magnesia. <i>Sulphas magnesiæ.</i>		{ <i>Magnesian vitriol.</i> <i>Bitter cathartic salt.</i> <i>Epsom salt.</i> <i>Salt (de canal).</i> <i>Salt of Seydewitz.</i> <i>Salt of Sedlitz.</i>
Sulphate of manganese. <i>Sulphas mangnesii.</i>		{ <i>Vitriol of manganese.</i>
Sulphate of mercury. <i>Sulphas hydrargyri.</i>		{ <i>Vitriol of mercury.</i>
Sulphate of molybdena. <i>Sulphas molybdeni.</i>		
Sulphate of nickel. <i>Sulphas niccoli.</i>		
Sulphate of gold. <i>Sulphas auri.</i>		
Sulphate of platina. <i>Sulphas platini.</i>		
Sulphate of lead. <i>Sulphas plumbi.</i>		{ <i>Vitriol of lead.</i>
Sulphate of potash. <i>Sulphas potassæ.</i>		{ <i>Vitriol of potash.</i> <i>Sal de duabus.</i> <i>Vitriolated tartar.</i> <i>Arcanum duplicatum.</i> <i>Sal polybreft of Glafer.</i>
Sulphate of soda. <i>Sulphas sodæ.</i>		{ <i>Glauber's salt.</i> <i>Vitriol of soda.</i>
Sulphate of tungsten. <i>Sulphas tungsteni.</i>		
Sulphate of zinc. <i>Sulphas zinci.</i>		{ <i>Vitriol of zinc.</i> <i>White vitriol.</i> <i>Vitriol of Cassar.</i> <i>White copperas.</i>
Sulphite. <i>Sulphis, tis.</i>		{ Salt formed by the combination of the sulphureous acid with different bases.

New Names.	N	Old Names.
Sulphite of alumine.		
<i>Sulphis aluminosus.</i>		
Sulphite of ammoniac.		
<i>Sulphis ammoniacalis.</i>		
Sulphite of antimony.		
<i>Sulphis stibii.</i>		
Sulphite of silver.		
<i>Sulphis argenti.</i>		
Sulphite of arsenic.		
<i>Sulphis arsenicalis.</i>		
Sulphite of barytes.		
<i>Sulphis baryticus.</i>		
Sulphite of bismuth.		
<i>Sulphis bismuthi.</i>		
Sulphite of lime.		
<i>Sulphis calcareus.</i>		
Sulphite of cobalt.		
<i>Sulphis cobalti.</i>		
Sulphite of copper.		
<i>Sulphis cupri.</i>		
Sulphite of tin.		
<i>Sulphis stanni.</i>		
Sulphite of iron.		
<i>Sulphis ferri.</i>		
Sulphite of magnesia.		
<i>Sulphis magnesie.</i>		
Sulphite of manganese.		
<i>Sulphis magnesi.</i>		
Sulphite of mercury.		
<i>Sulphis hydrargyri.</i>		
Sulphite of molybdena.		
<i>Sulphis molybdena.</i>		
Sulphite of nickel.		
<i>Sulphis niccæli.</i>		

New Names.	S	Old Names.
Sulphite of gold. <i>Sulphis auri.</i>		
Sulphite of platina. <i>Sulphis platini.</i>		
Sulphite of lead. <i>Sulphis plumbi.</i>		
Sulphite of potash. <i>Sulphis potasse.</i>	}	<i>Sulphureous salt of Stahl.</i>
Sulphite of soda. <i>Sulphis soda.</i>		
Sulphite of tungsten. <i>Sulphis tungsteni.</i>		
Sulphite of zinc. <i>Sulphis zinci.</i>		
Sulphur. <i>Sulphur.</i>	}	<i>Sulphur.</i>
Sulphur sublimated. <i>Sulphur sublimatum.</i>	}	<i>Flowers of sulphur.</i>
Sulphures, alkaline. <i>Sulphureta alkalina.</i>	}	<i>Alkaline liver of sulphur.</i>
	}	<i>Alkaline hepars.</i>
Sulphure of alumine. <i>Sulphuretum alumina.</i>		
Sulphure, ammoniacal. <i>Sulphuretum ammoniacale.</i>	{	<i>Fuming liquor of Boyle.</i>
		<i>Volatile alkaline liver of sulphur.</i>
Sulphure of antimony. <i>Sulphuretum stibii.</i>	}	<i>Antimony.</i>
Sulphure, native, of antimony. <i>Sulphuretum stibii nativum.</i>	{	<i>Ore of antimony.</i>
Sulphure of silver. <i>Sulphuretum argenti.</i>	}	<i>Blanchmal.</i>
Sulphure of barytes. <i>Sulphuretum baryte.</i>	}	<i>Barotic liver of sulphur.</i>
Sulphure of bismuth. <i>Sulphuretum bismuthi.</i>		

<i>New Names.</i>	S	<i>Old Names.</i>
Sulphure, calcareous. <i>Sulphuretum calcareum.</i>		{ <i>Calcareous liver of sulphur.</i>
Sulphure of cobalt. <i>Sulphureum cobalti.</i>		
Sulphure of copper. <i>Sulphuretum cupri.</i>		{ <i>Pyrites of copper.</i>
Sulphure of tin. <i>Sulphuretum stanni.</i>		
Sulphure of iron. <i>Sulphuretum ferri.</i>		{ <i>Martial pyrites.</i>
Sulphure of fixed oils. <i>Sulphuretum olei fixi.</i>		{ <i>Balsam of sulphur.</i>
Sulphure of volatile oil. <i>Sulphuretum olei volatilis.</i>		{ <i>Balsam of sulphur.</i>
Sulphure of magnesia. <i>Sulphuretum magnesiæ.</i>		{ <i>Liver of magnesian sulphur.</i>
Sulphure of manganese. <i>Sulphuretum magnesi.</i>		
Sulphure of mercury. <i>Sulphuretum hydrargyri.</i>		
Sulphures, metallic. <i>Sulphureta metallica</i>		{ <i>Combinations of sulphur with metals.</i>
Sulphure of molybdena. <i>Sulphuretum molybdæni.</i>		
Sulphure of nickel. <i>Sulphuretum niccoli.</i>		
Sulphure of gold. <i>Sulphuretum auri.</i>		
Sulphure of platina. <i>Sulphuretum platini.</i>		
Sulphure of lead. <i>Sulphuretum plumbi.</i>		
Sulphure of potash. <i>Sulphuretum potassæ.</i>		{ <i>Liver of sulphur with a base of fixable alkali.</i>

New Names.	S	Old Names.
Sulphure, antimoniated, of potash. <i>Sulphuretum potasse sibiatum.</i>	}	<i>Antimoniated liver of sulphur.</i>
Sulphure of soda. <i>Sulphuretum sodæ.</i>		
Sulphure, ammoniated, of soda. <i>Sulphuretum sodæ sibiatum.</i>	}	<i>Ammoniated liver of sulphur.</i>
Sulphure of tungsten. <i>Sulphuretum tungsteni.</i>		
Sulphure of zinc. <i>Sulphuretum zinci.</i>	}	<i>Blende, or false galena.</i>
Sulphures, earthy. <i>Sulphureta terrea.</i>	}	<i>Earthy livers of sulphur.</i>
	}	<i>Earthy bepari.</i>

T

Tartar. <i>Tartarus.</i>	}	<i>Crude Tartar.</i>
Tartarite. <i>Tartaris, tit. s. m.</i>	}	Salt formed by the combination of the tartareous acid with different bases.
Tartarite, acidulous, of potash. <i>Tartaris acidulus potasse.</i>	}	
Tartareous acidulum of potash. <i>Tartaris acidulus potasse.</i>	{	<i>Tartar.</i>
	{	<i>Cream of tartar.</i>
	{	<i>Crytals of tartar.</i>
Tartarite of alumine. <i>Tartaris aluminosus.</i>		
Tartarite of ammoniac. <i>Tartaris ammoniacalis.</i>	}	<i>Ammoniacal tartar.</i>
	}	<i>Tartareous ammoniacal salt.</i>
Tartarite of antimony. <i>Tartaris stibii.</i>		

New Names.	T	Old Names.
Tartarite of silver. <i>Tartaris argenti.</i>		
Tartarite of arsenic. <i>Tartaris arsenicalis.</i>		
Tartarite of barytes. <i>Tartaris baryticus.</i>		
Tartarite of bismuth. <i>Tartaris bismuthi.</i>		
Tartarite of lime. <i>Tartaris calcareus.</i>		{ Calcareous tartar.
Tartarite of cobalt. <i>Tartaris cobalti.</i>		
Tartarite of copper. <i>Tartaris cupri.</i>		
Tartarite of tin. <i>Tartaris stanni.</i>		
Tartarite of iron. <i>Tartaris ferri.</i>		
Tartarite of magnesia. <i>Tartaris magnesia.</i>		
Tartarite of manganese. <i>Tartaris magnesi.</i>		
Tartarite of mercury. <i>Tartaris hydrargyri.</i>		
Tartarite of molybdena. <i>Tartaris molybdeni.</i>		
Tartarite of nickel. <i>Tartaris niccoli.</i>		
Tartarite of gold. <i>Tartaris auri.</i>		
Tartarite of platina. <i>Tartaris platini.</i>		

<i>New Names.</i>	T	<i>Old Names.</i>
Tartarite of lead. <i>Tartaris plumbi.</i>	}	Saturnine tartar.
Tartarite of potash. <i>Tartaris potassæ.</i>	}	Soluble tartar.
		Tartarized tartar.
		Tartar of potash.
		Vegetable salt.
Tartarite, ammoniated, of potash. <i>Tartaris potassæ sibiatus.</i>	}	Stibiatis tartar.
		Tartar emetic.
		Ammoniated tartar.
		Emetic.
Tartarite, ferruginous, of potash. <i>Tartaris potassæ ferrugineus.</i>	}	Chalybeated tartar.
		Soluble martial tartar.
Tartarite of potash, fur-compounded of antimony. <i>Tartaris potassæ sibiatus.</i>	}	Tartarized tartar, containing antimony.
Tartarite of soda. <i>Tartaris sodæ.</i>	}	Tartar of soda.
		Polychrest salt of Rochelle.
		Salt of Seignette.
Tartarite of tungsten. <i>Tartaris tungsteni.</i>		
Tartarite of zinc. <i>Tartaris zinci.</i>		
Tin. <i>Stannum.</i>	}	Tin.
		Jupiter.
Tunstate. <i>Tungstas, tis. f. m.</i>	}	Salt formed by the combination of the tungstic acid with different bases.
		This genus of salt has no name in the old Nomenclature.
Tunstate of alumine <i>Tungstas aluminosus.</i>		
Tunstate of ammoniac. <i>Tungstas ammoniacalis.</i>		
Tunstate of antimony. <i>Tungstas stibii.</i>		

<i>New Names.</i>	T	<i>Old Names.</i>
Tunstate of silver.		
<i>Tunstas argenti.</i>		
Tunstate of arsenic.		
<i>Tunstas arsenicalis.</i>		
Tunstate of barytes.		
<i>Tunstas baryticus.</i>		
Tunstate of bismuth.		
<i>Tunstas bismuthi.</i>		
Tunstate of lime.		
<i>Tunstas calcareus.</i>		
Tunstate of cobalt.		
<i>Tunstas cobalti.</i>		
Tunstate of copper.		
<i>Tunstas cupri.</i>		
Tunstate of tin.		
<i>Tunstas stanni.</i>		
Tunstate of iron.		
<i>Tunstas ferri.</i>		
Tunstate of magnesia.		
<i>Tunstas magnesie.</i>		
Tunstate of manganese.		
<i>Tunstas magnesi.</i>		
Tunstate of mercury.		
<i>Tunstas hydrargyri.</i>		
Tunstate of molybdena.		
<i>Tunstas molybdeni.</i>		
Tunstate of nickel.		
<i>Tunstas niccoli.</i>		
Tunstate of gold.		
<i>Tunstas auri.</i>		
Tunstate of platina.		
<i>Tunstas platini.</i>		
Tunstate of lead.		
<i>Tunstas plumbi.</i>		

<i>New Names</i>	T	<i>Old Names.</i>
Tungstate of potash. <i>Tungstas potassæ.</i>		
Tungstate of soda. <i>Tungstas sodæ.</i>		
Tungstate of tungsten. <i>Tungstas tungsteni.</i>		
Tungstate of zinc. <i>Tungstas zinci.</i>		

W

Water.	<i>Water.</i>
Water, lime.	<i>Lime-water.</i>
Water, distilled.	<i>Distilled water.</i>
Waters impregnated with carbonic acid.	{ <i>Acidulous waters.</i> <i>Gaseous waters.</i>
Waters, sulphurated.	<i>Hepatic waters.</i>

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Zinc.

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TABLE I.

The Division and Characters of

A N

Having an			
With Not			
With Ea			
Two Ventricles in the Heart.			
Warm Blood.			
Inspiring and expiring the Air frequently.			
Viviparous.			
With Teats.			
1st Order.	2d Order.	3d Order.	4
QUADRUPEDS.	CETACEOUS ANIMALS.	BIRDS.	O Qu
Four Feet, and hairy Skin.	Fins, and no Hair.	Feathered.	Fou E



A T A R I.

38	METALLIC SUBSTANCES.	Antimony	-	<i>Regulus of antimony.</i>	-
39		Zinc.	-	-	-
40		Iron.	-	-	-
41		Tin.	-	-	-
42		Lead.	-	-	-
43	EARTHS.	Copper.	-	-	-
44		Mercury.	-	-	-
45		Silver.	-	-	-
46		Platina.	-	-	-
47		Gold.	-	-	-
48	ALKALIES.	Silex.	-	<i>Vitrifiable earth, quartz, &c.</i>	-
49		Alumine.	-	<i>Clay, or earth of alum.</i>	-
50		Barytes.	-	<i>Terro ponderosa.</i>	-
51		Lime.	-	<i>Calcareous earth.</i>	-
52		Magnesia.	-	-	-
53	ALKALIES.	Potash.	-	<i>Vegetable fixed alkali of tartar, &c.</i>	-
54		Soda.	-	<i>Mineral alkali, marine alkali, natrum.</i>	-
55		Ammoniac.	-	<i>Fluor, or caustic volatile alkali.</i>	Ammoniacal gas

* As the substances in the lower part of the column cannot be reduced

DENOMINATIONS newly appr

	1	2	3	4	
New Names	Mucous matter.	Glutinous matter, or gluten.	Sugar.	Starch.	Fix
Ancient Names.	Mucilage.	Glutinous matter.	Saccharine matter.	Amylaceous matter.	Fi

NAME		ADDRESS		CITY		STATE		ZIP	
Mr. J. H. Smith	123 Main St.	Springfield	Ill.	62761					
Mr. W. R. Jones	456 Oak Ave.	Chicago	Ill.	60605					
Mr. T. L. Brown	789 Elm St.	Peoria	Ill.	61603					
Mr. S. K. Davis	101 Maple Dr.	Rockford	Ill.	61101					
Mr. P. M. Wilson	234 Cedar Ln.	Decatur	Ill.	62521					
Mr. Q. N. Taylor	567 Birch St.	Normal	Ill.	62451					
Mr. R. O. White	890 Pine Ave.	Urbana	Ill.	62501					
Mr. V. P. Green	112 Spruce Dr.	Champaign	Ill.	61821					
Mr. X. Y. Black	145 Ash St.	Carbondale	Ill.	62901					
Mr. Z. A. Gray	178 Hickory Ln.	Macomb	Ill.	61455					
Mr. B. C. Hall	201 Walnut Ave.	Edwardsville	Ill.	62025					
Mr. D. E. King	234 Cherry St.	St. Louis	Mo.	63103					
Mr. F. G. Lee	267 Elm Dr.	St. Charles	Mo.	63071					
Mr. H. I. Miller	290 Oak Ave.	St. Joseph	Mo.	64501					
Mr. J. K. Moore	323 Maple St.	St. Louis	Mo.	63104					
Mr. L. M. Taylor	356 Pine Ln.	St. Louis	Mo.	63105					
Mr. N. O. White	389 Cedar Dr.	St. Louis	Mo.	63106					
Mr. P. Q. Green	412 Birch St.	St. Louis	Mo.	63107					
Mr. R. S. Black	445 Ash Ave.	St. Louis	Mo.	63108					
Mr. T. U. Gray	478 Hickory Dr.	St. Louis	Mo.	63109					
Mr. V. W. Hall	501 Walnut St.	St. Louis	Mo.	63110					
Mr. X. Y. King	534 Cherry Ave.	St. Louis	Mo.	63111					
Mr. Z. A. Lee	567 Elm Dr.	St. Louis	Mo.	63112					
Mr. B. C. Miller	590 Oak St.	St. Louis	Mo.	63113					
Mr. D. E. Moore	623 Maple Ave.	St. Louis	Mo.	63114					
Mr. F. G. Taylor	656 Pine Dr.	St. Louis	Mo.	63115					
Mr. H. I. White	689 Cedar St.	St. Louis	Mo.	63116					
Mr. J. K. Green	712 Birch Ave.	St. Louis	Mo.	63117					
Mr. L. M. Black	745 Ash Dr.	St. Louis	Mo.	63118					
Mr. N. O. Gray	778 Hickory St.	St. Louis	Mo.	63119					
Mr. P. Q. Hall	801 Walnut Ave.	St. Louis	Mo.	63120					
Mr. R. S. King	834 Cherry Dr.	St. Louis	Mo.	63121					
Mr. T. U. Lee	867 Elm St.	St. Louis	Mo.	63122					
Mr. V. W. Miller	890 Oak Ave.	St. Louis	Mo.	63123					
Mr. X. Y. Moore	923 Maple Dr.	St. Louis	Mo.	63124					
Mr. Z. A. Taylor	956 Pine St.	St. Louis	Mo.	63125					
Mr. B. C. White	989 Cedar Ave.	St. Louis	Mo.	63126					
Mr. D. E. Green	1012 Birch Dr.	St. Louis	Mo.	63127					
Mr. F. G. Black	1045 Ash St.	St. Louis	Mo.	63128					
Mr. H. I. Gray	1078 Hickory Ave.	St. Louis	Mo.	63129					
Mr. J. K. Hall	1111 Walnut Dr.	St. Louis	Mo.	63130					
Mr. L. M. King	1144 Cherry St.	St. Louis	Mo.	63131					
Mr. N. O. Lee	1177 Elm Ave.	St. Louis	Mo.	63132					
Mr. P. Q. Miller	1210 Oak Dr.	St. Louis	Mo.	63133					
Mr. R. S. Moore	1243 Maple St.	St. Louis	Mo.	63134					
Mr. T. U. Taylor	1276 Pine Ave.	St. Louis	Mo.	63135					
Mr. V. W. White	1309 Cedar Dr.	St. Louis	Mo.	63136					
Mr. X. Y. Green	1342 Birch St.	St. Louis	Mo.	63137					
Mr. Z. A. Black	1375 Ash Ave.	St. Louis	Mo.	63138					
Mr. B. C. Gray	1408 Hickory Dr.	St. Louis	Mo.	63139					
Mr. D. E. Hall	1441 Walnut St.	St. Louis	Mo.	63140					
Mr. F. G. King	1474 Cherry Ave.	St. Louis	Mo.	63141					
Mr. H. I. Lee	1507 Elm Dr.	St. Louis	Mo.	63142					
Mr. J. K. Miller	1540 Oak St.	St. Louis	Mo.	63143					
Mr. L. M. Moore	1573 Maple Ave.	St. Louis	Mo.	63144					
Mr. N. O. Taylor	1606 Pine Dr.	St. Louis	Mo.	63145					
Mr. P. Q. White	1639 Cedar St.	St. Louis	Mo.	63146					
Mr. R. S. Green	1672 Birch Ave.	St. Louis	Mo.	63147					
Mr. T. U. Black	1705 Ash Dr.	St. Louis	Mo.	63148					
Mr. V. W. Gray	1738 Hickory St.	St. Louis	Mo.	63149					
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